Editorial

BRITAIN'S commercial television is getting under way. Under the Independent Television Authority's watchful eye, three stations are expected to be operating in about 12 months time, issuing programs from three stations which will cover about half the population of the United Kingdom.

They will be able to do this each with an estimated range of 40 miles.

One will be located in the London area, one in the Midlands, and one in the north of England probably in the Pennines. More stations will be set up later on, and eventually there will be commercial programs available throughout the British Isles.

The authority was established under the TV Act of 1954 to provide services for a period of 10 years. Programs will be supplied by contractors who will also be responsible for their finance.

The use of advertising matter will be rigidly controlled under the terms of the contract. The programs themselves must not contain advertising matter or be slanted towards advertising. They must provide entertainment. Advertisements will be inserted either at the beginning and end of the programs, or during natural breaks. The authority has wide powers to control such matters, and even to impose heavy fines for breaches of contract.

Commercial TV and commercial radio in Britain thus breaks the monopoly on air entertainment enjoyed by the BBC ever since radio began. From now on there will undoubtedly be a big change in British home entertainment, and it can only be for the better.

One hopes that the powers of the TV authority will not be merely an extension of the BBC type of control in another sphere. This is not criticism of the BBC.

I mean rather that private enterprise can bring a new, refreshing viewpoint which can only brighten the future. It will provide competition and the stimulus which no monopoly can command.

The new move, whether considered as an economic necessity or an inevitable desire for wider expression does highlight our own wisdom in planning a dual system for Australia. It would have been a tragic mistake if things had been otherwise.

At the moment America in particular is dotted with Australian executives and engineers learning about TV against the inevitable day. The dawn may still be some distance away, but nothing can stop it now.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

The Army's new portable field transmitter - receiver will work work under water, as this picture shows. It was designed and manufactured in Australia by AWA and has intrigued the world.

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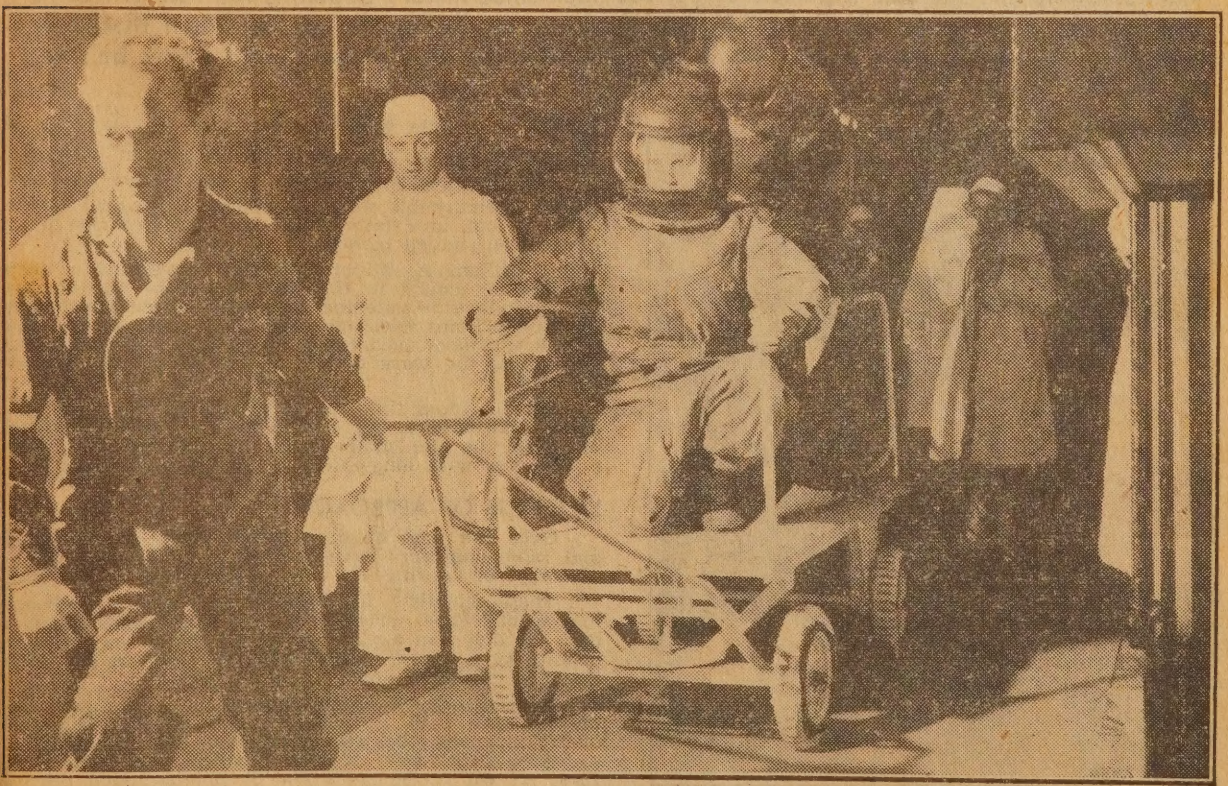
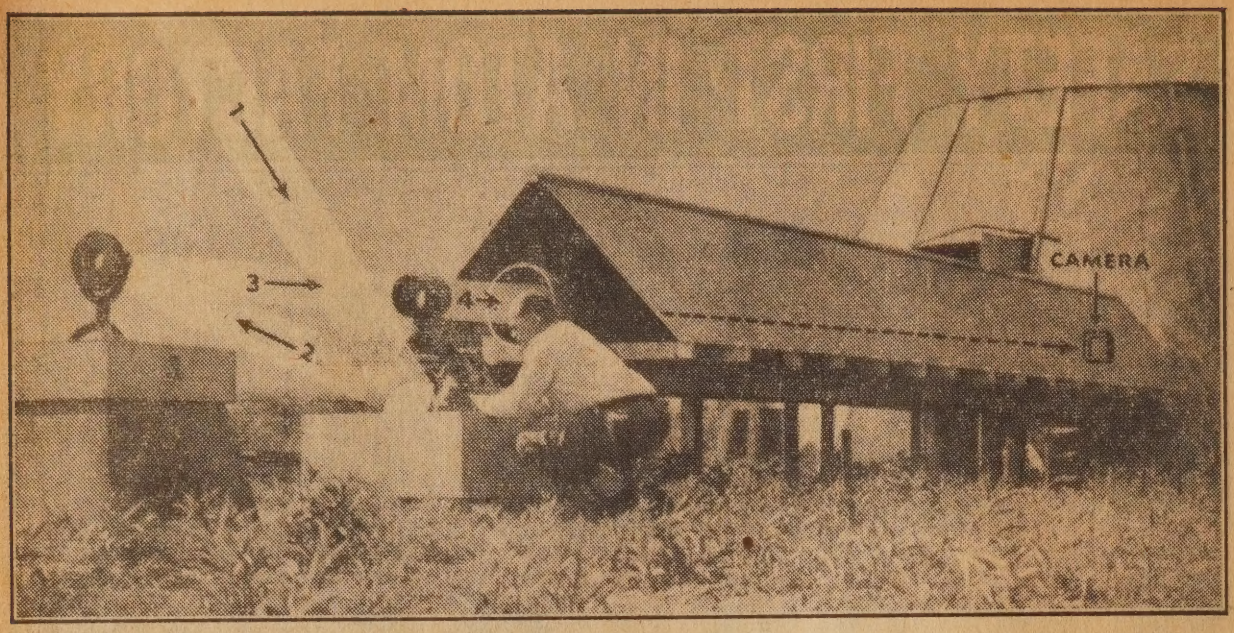
SAFETY FIRST IN ATOM FACTORY

In Britain's secret atom factory at Windscale, extreme precautions are taken to safeguard the safety of workers. Here is the "glove-box" laboratory. Holes in the shield partition are fitted with protective gloves large enough to take the whole arm when handling "hot" specimens.



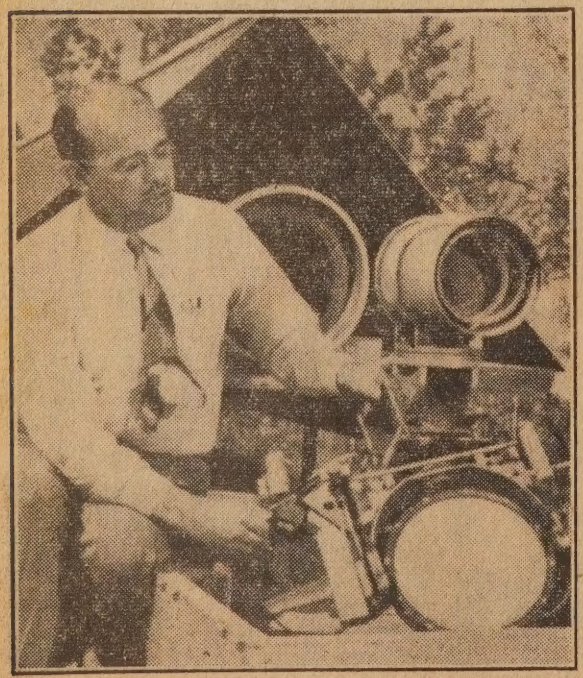
Maintenance workers in protective suits are transferred round the building in trolleys to avoid possible radio-active dust on their clothing from being spread throughout the building. Suits are fitted with walkie-talkies for communication. (Story on atom power on page 13.)



An RCA research team at Rocky Point, L.I., uses this system to photograph the face of the sun. Sun's rays (1) strike clock-driven mirror which reflects them (2) directly stationary mirror. The image is then directed (3) at six-inch telescope lens, which passes it in magnified form (4) along 40-foot pipe to camera plate holder in structure at rear.

THEY EXPLORE THE SUN'S FACE

Contemplation of the sun, a pursuit of curious men since history began, is the task at RCA's Rocky Point, L.I. laboratories, of a physicist and two engineers who are confident that their venture into astronomy is harvesting down-to-earth knowledge of how radio waves behave.



Dr. William A. Miller examines clock-driven mirror with which the sun is tracked for the improvised telescope.

WITH a simple telescope, the working elements of which are the ends of a 40-foot section of glazed tile pipe, the Rocky Point solar research team has been taking a remarkable series of photographs which enable them to look at details of the sun's surface that have never been studied before.

Dr. William A. Miller, who has developed a deep aversion to clouds in the three years he has headed this unique sun-watching program, is convinced that the Rocky Point telescope, and the techniques that the tanned trio have mastered in using it, are already complementing the work of the world's great solar observatories.

At the same time, he is optimistic that their research can lead to more precise and simpler methods of predicting the solar-caused disturbances that play such havoc with long-range radio communications.

METHODS OF APPROACH

Over the past hundred years, physicists, chemists and radio engineers have devised a number of ingenious ways of figuring out what is happening on the sun.

These scientists, for example, can split a sunbeam in a spectroscope's prism and learn of the sun's chemistry. Or they can apply theories of atomic and nuclear physics to mysteries of the solar furnace, an approach that has explained much in recent years.

By charting the relationships between changes seen on the sun, such as sunspots, and unusual behavior of radio signals, other clues have been made available.

Among the most fruitful investigations have been those in which the sun's rim is photographed during an eclipse, producing spectacular and informative pictures of violent solar activity. With optically simulated eclipses (coronagraphs), astronomers have taken many more silhouettes of the sun's outer atmosphere.

A neglected approach, however, is examination of the sun "full-face" instead of profile, and photographing sections of its surface in great detail. It is to this technique that the Rocky Point group is devoting so much of its effort.

"Head-on" examination of the sun's surface, though not new, is a method virtually dormant for years.

In the 1870's the famous French astronomer, Pierre Jules Cesar Janssen, took such pictures and was able to show, for the first time, the granular, "cooked-cereal" texture of the solar system.

Janssen's classic photographs have appeared in standard texts over the years as the best of their kind. But they were, in many ways, ahead of their time and raised as many astronomical questions as they answered.

EFFECT OF ALTITUDE

Speculating on the hiatus of detailed "full-face" solar photography since Janssen's time, Dr. Miller points out that most modern solar observatories have been perched at higher and higher altitudes to take advantage of the increased transparency of the earth's atmosphere.

Though these mountain-top sites give many occasions of good viewing of the sun's outer atmosphere—the corona and chromosphere—they are usually the worst possible locations for seeing the solar disc in great detail. The sun heats the air around the mountain, violent updrafts form and the sun's image dances in an optical instrument.

Rocky Point, on the other hand, turns out to be one of the world's best spots for what Dr. Miller terms "optical tranquility". The flat terrain of Long Island usually allows a smooth flow of air, carried by the prevailing southerly winds, across the Rocky Point area and into Connecticut before turbulence and thunderstorms develop.

Contrary to expectations, the frequent Long Island haze does not normally interfere with their solar photographs and is viewed by the Rocky Point group as a good omen indicating the atmosphere above them is quiet.

Getting their best results in the late spring, summer and early fall, the team has had over the past two years an average of 75 days when they made pictures whose details was limited only by the resolving power of their 6-inch telescope. (Janssen, it is interesting to note, took only 25 to 30 comparable shots in a decade.)

Twice as many additional days a year are suitable for taking valuable, if not, perfect pictures of the sun.

"Give us just two minutes' break in the clouds and we'll get a shot," says Dr. Miller.

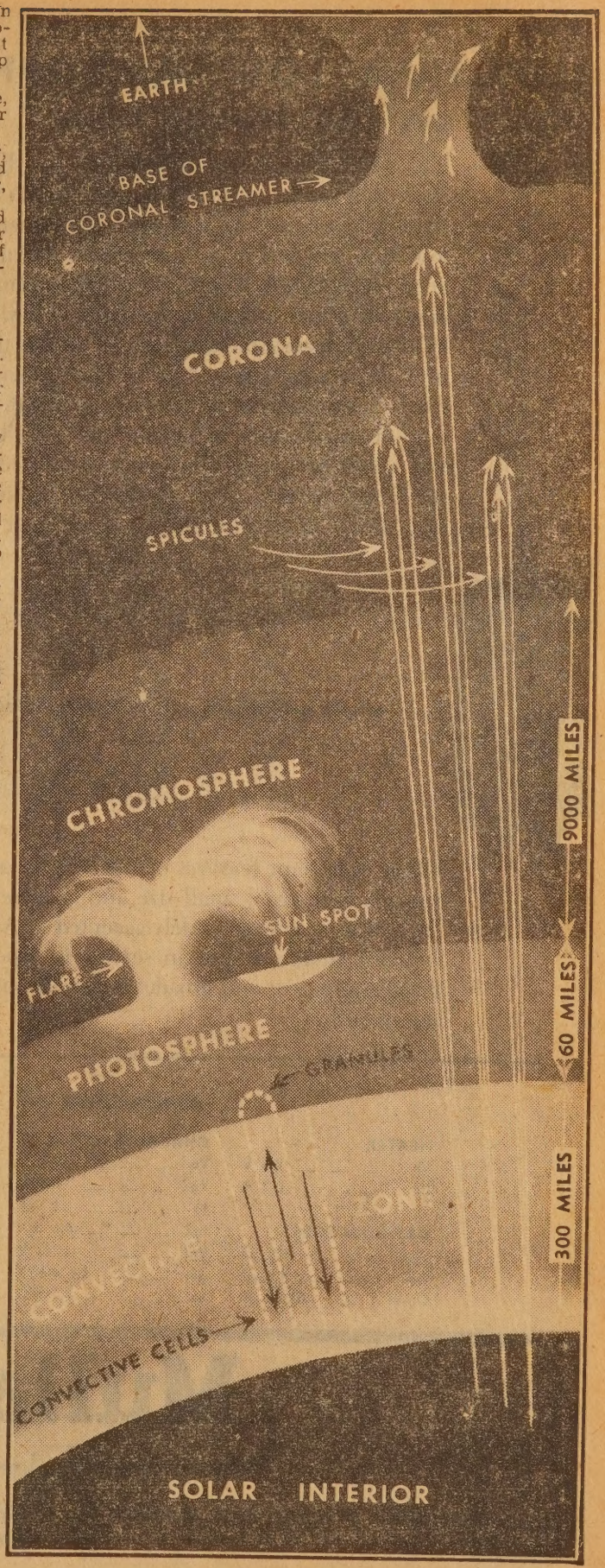
As their pictures pile up, the teams see emerge a definite pattern of details that may well form the basis of a valuable radio prediction service.

THE IONOSPHERE

Radio engineers have realised for some time that long-range high-frequency communication is feasible because of layers of ionised gas lying in thick spherical shells around the earth's surface. The layers of the ionosphere (a zone lying 50 to 300 miles above us) act as mirrors reflecting radio waves back to the earth's surface.

If these layers were fixed in altitude and constant in their electrical reflecting properties, there would be no problem. But this is hardly the case. To circumvent the vagaries of the ionosphere, radio stations must constantly change frequencies or re-route circuits.

Fortunately, some of the variations in the ionosphere can be anticipated. Seasonal changes and nocturnal changes, for example, have been well charted simply by observing actual radio circuits year after year. But most of the changes are more elusive. Some appear to be completely random. Others may recur more or less regularly, but with unpredictable intensity.



In profile at various levels of the sun's atmosphere are some of the phenomena the Rocky Point group are observing in full-face studies of the solar disc (see photograph on page 7). The photosphere is the layer visible to the eye; outer zones are more rarified. Both the eruptive flare and jet-like spicules are believed to be near the start of different chains of events that often disrupt long-distance radio communications on earth. Also under scrutiny are granules, which give sun's face a "cooked-cereal" texture in photographs.

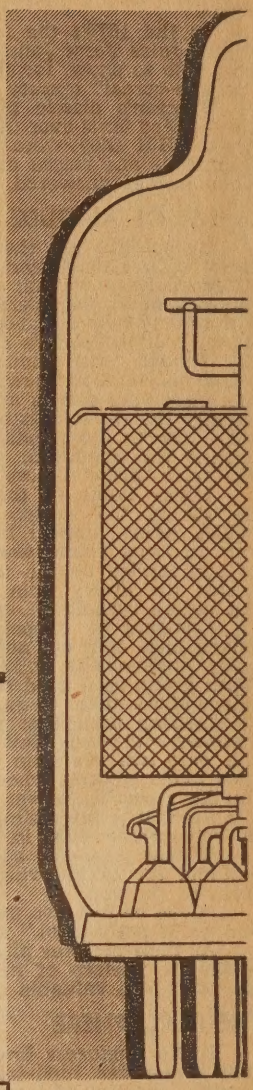
LOW HUM, LOW MICROPHONY, A.F. PENTODE on the Noval Base

The Mullard A.F. pentode, EF86, has been especially designed for use in resistance-coupled, audio frequency, voltage amplifier circuits. An essential requirement of such circuits, low hum and low microphony from the amplifying valve, is achieved with the EF86 by careful internal screening, rigid electrode structure and by the use of a bifilar heater.

Whilst in normal circuitry the EF86 has the low hum figure of 5 micro-volts referred to the control grid, even this figure can be improved. As the control grid pin of the EF86 is placed equi-distant from its two heater pins, any hum induced from the heater pins may be virtually balanced out by providing the heater winding with an earthed centre-tap. Used in this way, the EF86 has a hum figure of the order of 1.5 micro-volts.

ACTUAL SIZE

EF86



Other important features of this voltage amplifying pentode include high gain, small size and single-ended construction. The EF86 is already widely accepted by Australian engineers —many thousands are in service in tape recorders, amplifying equipment and broadcast stations throughout the Commonwealth.

M5

ABRIDGED DATA

HEATER		CHARACTERISTICS		BASE
Vh	6.3 V	Va	250 V	89A (Noval)
Ih	0.2 A	Vg2	140 V	
		Ia	3 mA	**DIMENSIONS**
CAPACITANCES		Ig2	0.6 mA	Max. seated height
Cout	5.5 pF	Vgl	-2 V	49 mm.
Cin	4.0 pF	gm	1.8 mA/V	Max. bulb diameter
Ca-gl	0.025 pF	ra	2.5 MΩ	22 mm.

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Dr. Miller's group is particularly anxious to pin down the latter disruptions because they cause the most distress.

As Dr. Miller explains it, there are two ways in which the sun can influence the ionosphere. First, by direct electro-magnetic radiation — x-rays or ultraviolet rays — which travel at the speed of light from the sun to the ionosphere in eight minutes.

Such bursts of radiation from the sun appear to be the cause of sudden and often complete radio fade-outs called Dellinger fades. Fortunately, these last for only 20 or 30 minutes and never more than two or three hours.

The second way the sun is believed to alter the ionosphere is by sending out actual streams of ionised particles. Such solar bombardments travel more slowly than radiation, taking two or three days to make the 93-million-mile journey. They are considered a likely cause of the so-called magnetic storms.

These rare but violent disturbances, which may not be felt for years at a time, can knock out radio communications for days and can so disrupt the earth's magnetic field as to cripple wire and cable communications as well.

That both radiation and beams of particles can be agents of ionospheric caprices is evidenced by the fact that radiation as felt in a Dellinger fade is disruptive only on the sunny half of the earth.

The research team lines up sun's images on screen before exposing film in the camera plate holder. Left to right are A. B. Moulton, Ralph E. Franklin and Dr. Miller.

SHOWER OF PARTICLES?

A great magnetic storm, on the other hand, will be felt simultaneously on the light and dark hemispheres, suggesting that the earth is passing through a great shower of particles which have been rapidly dispersed throughout the ionosphere by the earth's magnetic field.

Astronomers are fairly well agreed that both these types of disturbance spring from the same phenomenon—solar flares. These sudden, short-lived brightenings of small regions of the sun's surface are usually seen in the neighborhood of sunspots.

Flares are often noticed at the time of the Dellinger fade, and they appear to project enough radiation to account for this phenomenon on the earth.

When great magnetic storms occur they follow by two or three days a Dellinger fade, which would suggest they are the result of a properly directed beam of particles spewed out by the same flare that produced radiation for the Dellinger fade.

In addition, both of these ionospheric upsets are more frequent during the peak years of the 23-year sunspot cycle, which is also the time of the greatest number of observed flares.

It would simplify the propagation expert's life if the solar flare could be named the villain of all radio communication breakdown, not just the Dellinger fades and great magnetic storms. Unhappily, the flare, according to most theories, can be assigned only a relatively minor role.

Flares are short-lived and erratic while the ionosphere disturbances that yet elude full explanation — the somewhat regular ones known as M-region disturbances—appear to be caused by something that lives for many months on the sun, reappearing several times in rough synchronisation with the sun's 27-day rotational period.

Gaining support from experts is the hypothesis that the sun's outer atmosphere, the corona, has at all times a number of invisible long arms that sweep out millions of miles into space. Some of these coronal streamers would be semi-permanent projections of the corona, lasting for several cycles of the sun's 27-day rotational period.

The Rocky Point trio is working with other solar observers to check the validity of this theory.

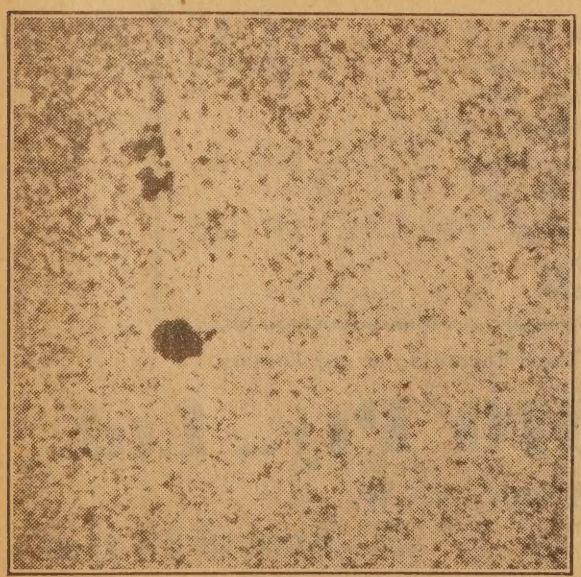
"STREAMER" THEORY

A goal of Dr. Miller's current studies is to establish beyond a doubt what it is on the sun's surface that can build up the corona to such an extent that a streamer will be cast out into space. The Rocky Point photographs are, as he puts it, "not in disagreement with modern theories of the corona and the formation of streamers".

The detailed "full-face" photographs do not reveal the whispy streamers themselves, but they do show a generous sprinkling of black dots which have never been "isolated" before.

These dots, Dr. Miller explains, are probably a bird's-eye view of the solar spicules, a short-lived but common activity of the sun, first discovered, on the sun's rim, only 14 years ago. They may well be long narrow jets of heated material from the interior of the sun that pop right through the sun's surface, spewing new matter up into the corona.

(Continued on Page 19)



Minute section of sun's face, showing granular texture of the solar surface. Large black areas are sunspots: the tiny black dots are believed to be "spicules" — jets of heated material rising from the interior of the sun.

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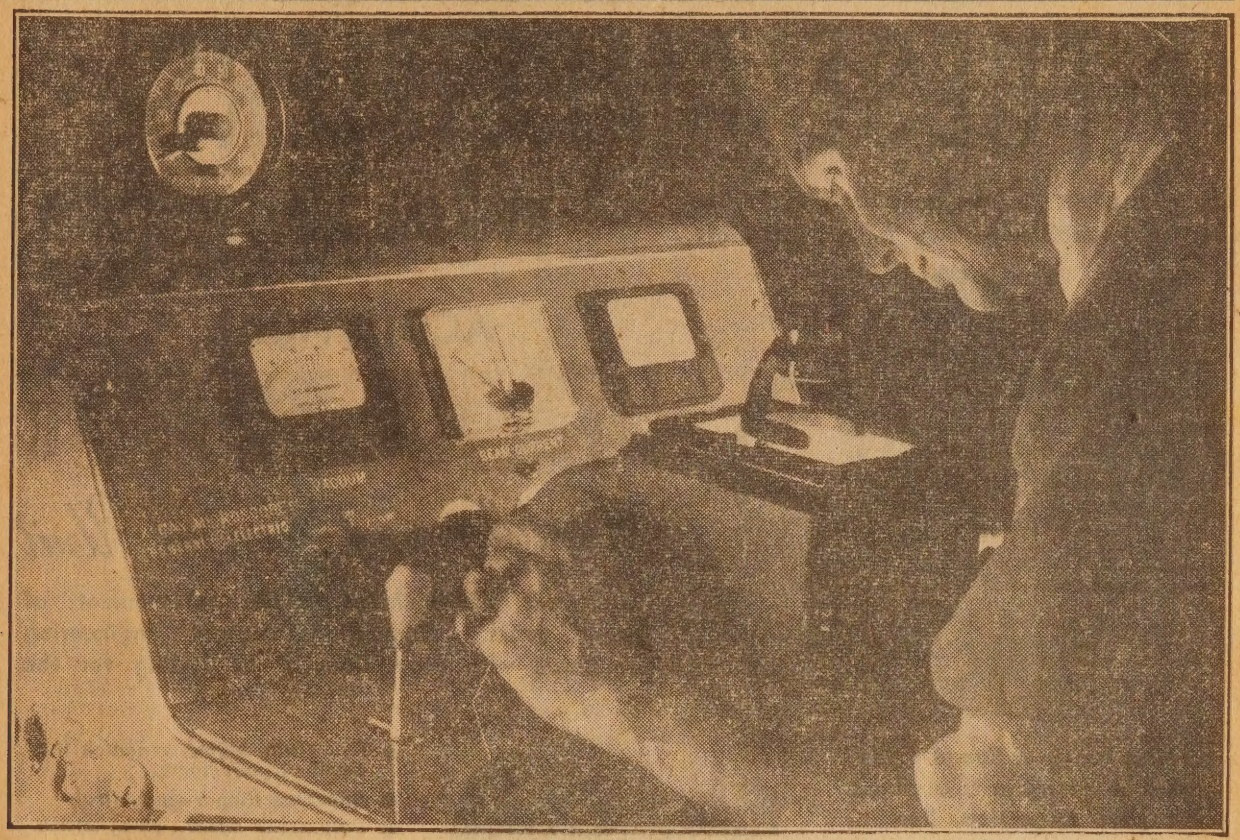
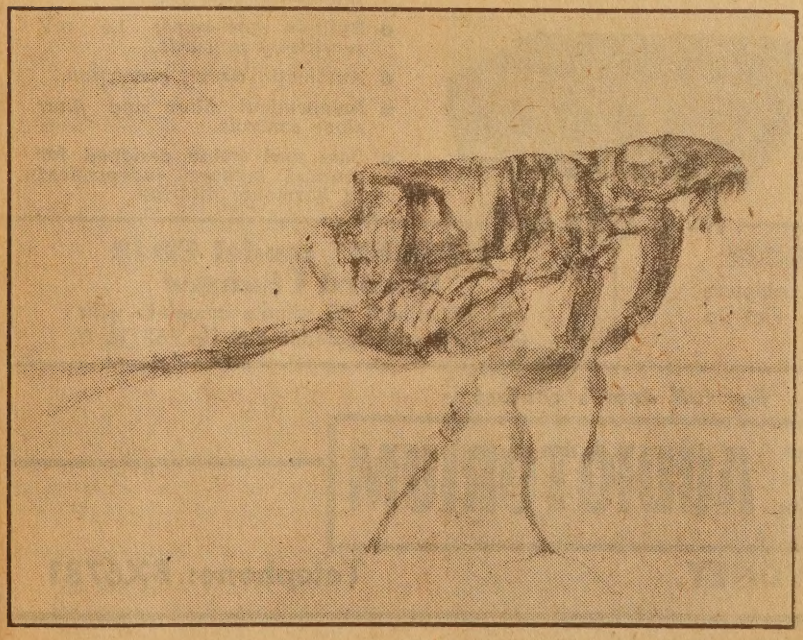


An engineer operates the controls of the new x-ray microscope which reveals the structure of objects through which light will not pass. It is now undergoing final development.

Instruments which permit us to examine very small objects have been extremely valuable to the research scientist, and in fact to almost every industrial worker. Microscopes have been made which enable us to see things so small that light waves are too long to resolve them.



An excellent picture of a common dog flea which shows clearly what makes it tick. The original clear picture was several times the size of this reproduction.

THESE microscopes, such as the electron microscope, have added enormously to our stock of knowledge, for to the eye which can magnify a hundred thousand times there is a whole new world to see and experience.

Now the G-E company announces that it has perfected an x-ray microscope, the first they claim which can be produced in quantity.

X-rays have been in use for a long time, their most spectacular application being in the field of medicine. They have a unique quality allowing us to see within the body of the object being observed, so that its internal structure is largely laid bare.

X-RAY USES

Most of us have had x-ray pictures taken at one time or another. Dentists use them freely as a guide

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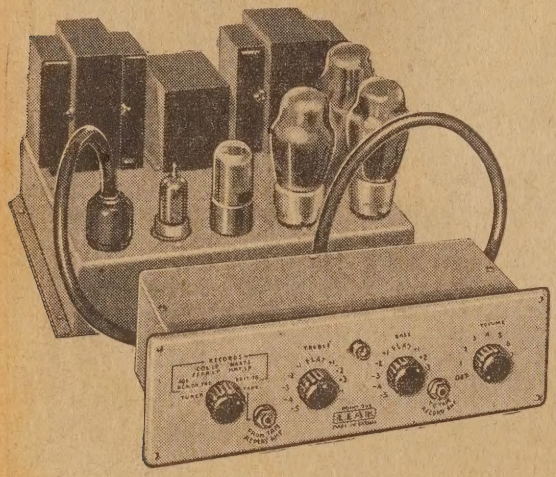

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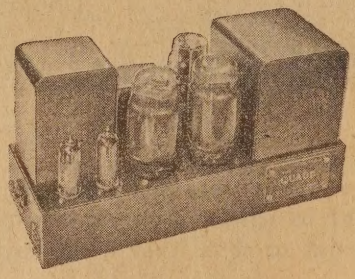
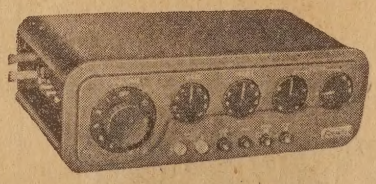
All Types Microphones





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before extractions and the like. They are one of the best detectors of possible tuberculosis, so much so that a nation-wide x-ray campaign exists in this country to ensure that everyone undergoes examination by x-ray photography.

But there have been difficulties in photographing extremely small objects, mainly because it has been hard to make a conventional x-ray source small enough. About one-eighth of an inch is the smallest to date, whereas a source as small as 1/1000th of an inch would be needed to allow magnification as great as an ordinary reading glass.

SOLVES PROBLEM

This problem, it is claimed, has been solved in the new instrument, which is in its last stages of development.

It provides a magnification of up to 1500 diameters, enough to allow examination of the grain structure in metals, the cell structure of bones and human tissue, the internal organs of tiny insects, and other objects opaque to light waves. It should therefore find ready application in medical science, biology and industry.

The principle feature of the instrument is an electro-static lens system which provides an x-ray source 300 times smaller than a human hair.

This is the key to the design, for the larger the x-ray source, the lower the potential magnifications of the specimens.

MANY USES

The pictures shown here of actual x-ray photographs illustrate clearly how valuable they are. In the photograph of the flea, the segmented underparts, muscle fibres (dark vertical bands in the centre of the back), clearly defined eye, and hook-like claws (one of which holds a strand of cotton) are all visible.

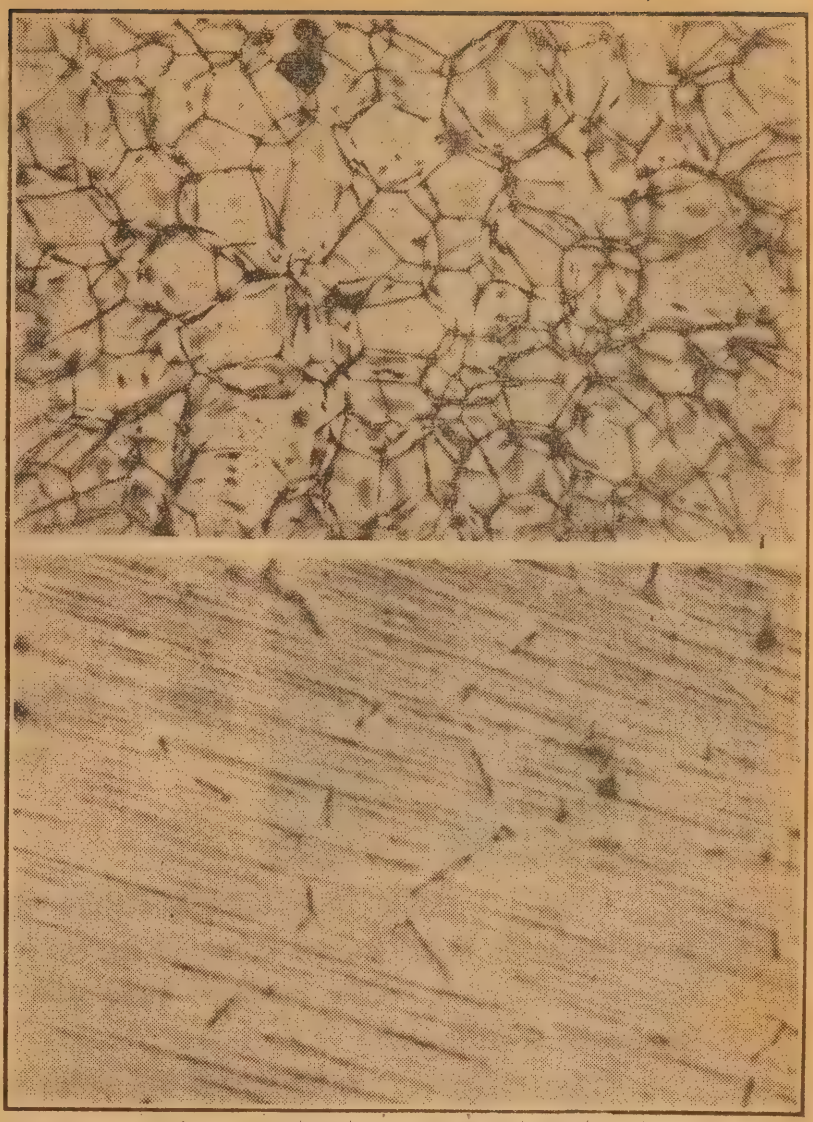
The tiny portion of aluminium-tin alloy looks like a huge, multi-faceted diamond under the microscope. It sees through the alloy to reveal tin at the edges of the aluminium grain boundaries (black lines) and on the faces of other grain boundaries (grey patches).

COMPARISON

The bottom part of the composite photo shows the same sample seen under an ordinary light microscope. It reveals only surface scratches and tin that happens to be on the surface of some grain boundaries.

This photograph shows how helpful the microscope will be to metallurgists in their search for lighter, stronger metals for use in aircraft motor bearings, as example.

Finally the picture of the nylon stocking shows with extreme clarity the structure of the weave. The symmetry of the nylon loops is indicative of the elastic memory that enables each strand to regain its original shape after stretching.



TOP—A small portion of aluminium-tin alloy seen through the x-ray microscope.
BOTTOM—The same sample seen through an ordinary light microscope.

This picture of a nylon stocking shows the reason for its gossamer lightness. Each strand and loop is clearly visible.

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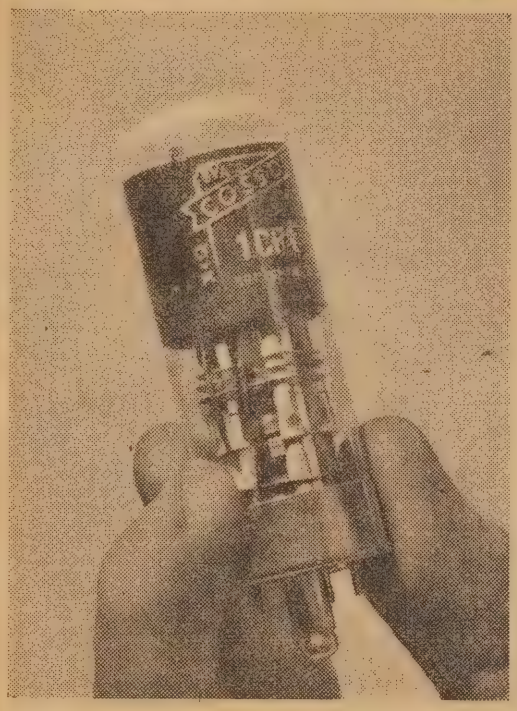

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Max. diameter	30 m.ms
Screen diameter	25 m.ms.
Base	Lock-in B8G.
Heater volts	6.3
Heater current	0.6 amps.
Anode Volts	500/800
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Deflection	Electrostatic
Focus	Automatic
Screen	Green, short persistence

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NUCLEAR REACTORS FOR POWER

The world's sources of power are being severely taxed by the demands of today, and future development will depend greatly on the eventual use of atomic energy. In this article our contributor has the requirements of Great Britain in mind, but these are just as applicable to Australia which will make enormous power demands in the years to come.

By "PHYSICIST"

IT has been calculated that at the existing rate of fuel consumption the world supplies of coal and oil will only last for about 400 years. If the demand for fuel increases as expected, by the year 2000 these will be used up at such an alarming rate that they will hardly last for another 80 years.

On the other hand, if all the economically accessible uranium and thorium could be converted into energy by nuclear fission, they would meet the world fuel needs for at least 1700 years, even at the rate of consumption expected by the year 2000!

NUCLEAR FISSION

The release of atomic energy as we know it today is based on the fact that when the nuclei of certain atoms are bombarded with minute particles of matter they are split into two smaller atoms and, in the process, a small amount of matter is annihilated and appears as energy, see Fig. 1.

Of course, in every process of power generation some of the energy which is associated with the atoms of the fuel is liberated, but in atomic fission the amount of energy liberated is very much greater—so much so, that as much energy can be obtained from one pound of atomic fuel as from 2.5-million tons of high-grade coal.

It was found that when uranium was bombarded with electrically neutral particles called neutrons, certain atoms underwent this fission process, giving out considerable energy and at the same time yielding two or more neutrons which could, under favorable conditions, collide with neighboring atoms and cause them to split.

Clearly, here was a self-sustained process which, when once initiated, would maintain itself. Its potentialities as a military weapon were quickly realised and studies to determine the ultimate speed with which fission could occur led to its use in the atom bomb toward the end of World War II.

ISOLATING URANIUM

Three materials have been found in which these chain fission reactions can be induced, viz., uranium 233, uranium 235, and plutonium 239. (The numbers after the name of the material refer to its atomic weight.) The first two are different forms of the same element and are called isotopes, but the third is an isotope of a different element, plutonium, which is man-made.

Nuclear fission was first discovered in naturally occurring uranium and was found to be due to the isotope of atomic weight 235, which is present only to the extent of 0.7 pc.

For military purposes, where it is essential to have the maximum amount of energy liberated in the least possible time and where the size and weight of the weapon are important factors, it was necessary to isolate the uranium 235 from the natural material, but for power production this is not essential and a slower evolution of energy can be tolerated.

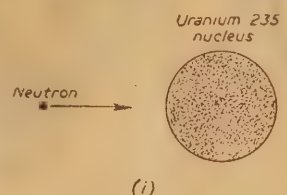


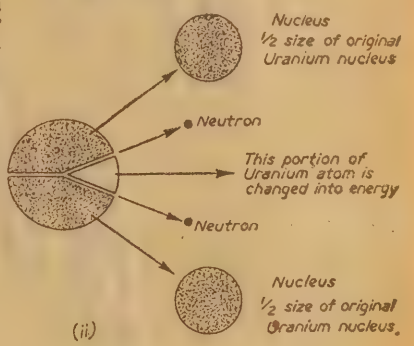
Figure 1: Mechanism of nuclear fission by neutron bombardment.
(i) Neutron approaching uranium 235 nucleus.
(ii) After impact with neutron, uranium 235 nucleus splits into; (a) two nuclei of approximately half size of uranium nucleus; (b) two more neutrons; (c) portion of matter from the nucleus (considerably less than shown in this figure) is annihilated and converted into energy.

It was subsequently discovered that another isotope of uranium, viz. uranium 238, which does not undergo fission directly can capture neutrons, thus becoming uranium 239.

This isotope is very unstable and emits an electron from its nucleus to become an isotope of a new element—neptunium 239. Within a short while another electron is emitted from the nucleus of this element and another new element, plutonium 239, is formed. This material is as valuable as uranium 235, because it also undergoes fission with the evolution of energy and, therefore, is used in atomic weapons, see Fig. 2.

(1) Uranium 238 + neutron → uranium 239.
(2) Uranium 239 → neptunium 239 + electron.
(3) Neptunium 239 → plutonium 239 + electron.
(4) Plutonium 239 + neutron → 2 nuclei of half atomic weight of plutonium 239 + two or more neutrons + energy.

Figure 2: Schematic representation of the derivation of plutonium 239 from uranium 238 and the fission of this material.
(Note that the neutron has an atomic weight of 1 and no electric charge, but that the electron is virtually weightless but has unit negative charge.)



Another fissionable, man-made material has also been discovered and is made by bombarding thorium 232 with slow-moving neutrons. This gives thorium 233, an unstable isotope which emits an electron from its nucleus to become protoactinium 233 and this, in turn, becomes uranium 233 after emitting another electron (Fig. 3.) Uranium 233 is also fissile and has certain advantages over plutonium 239, for there are substantial supplies of thorium in the world and uranium 233 is much less dangerous to health than plutonium 239. It is also easier to separate from its parent isotope than plutonium 239.

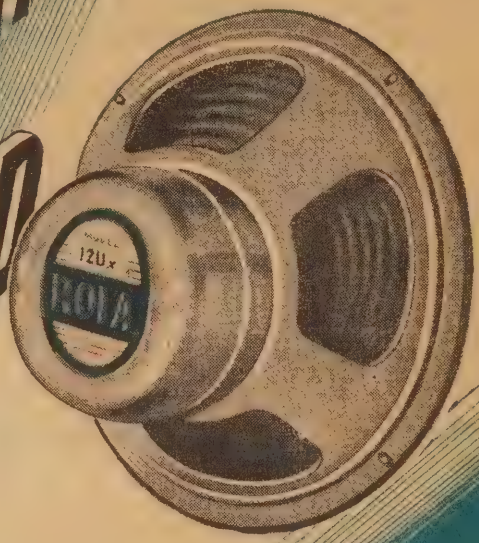
Both plutonium 239 and uranium 233 are made in what are known as "breeder" piles. Basically, these are designed to "burn" a primary nuclear fuel, such as uranium 235, and produce an equivalent amount of another atomic fuel in addition to giving out energy.

BREEDER PILE

An idealised "breeder" pile is shown diagrammatically in Fig 4. Such a pile or reactor would consist of a central region containing pure primary fuel surrounded by a shell of the material to be converted into the secondary fuel. The whole would be enveloped in a radiation shield to protect the operators from exposure to the atomic radiations.

Ideally, in this type of reactor the fission reactions would be confined to the core, but the neutrons liberated therein would penetrate the surrounding material and produce transmutation of the material. The energy liberated during the fission processes occurring in the core, which

SPOTLIGHT on SOUND



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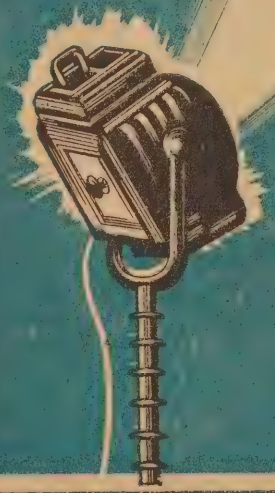

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appears mainly as heat, would be removed by a coolant circulating around the core.

Unfortunately, such an idealised system is not likely to be realised in practice, for the fission reactions cannot wholly be confined to the core.

Attention is, at present, focused on the use of atomic energy in electric power production and this is likely to prove its first major peaceful application.

Because the energy is transformed in bulk, before transmission to the individual users, it offers certain advantages in so far as expensive and complicated equipment need not be duplicated and suitable safety precautions can be taken to guard against the harmful effects of the fission materials.

COST COMPARISON

Fundamentally, the generating equipment of the atomic power stations will be conventional; the nuclear reactor merely replacing the boiler of the normal power station.

The generating and transmission costs of the atomic power station will be much the same as for a normal power station and what economies there might be will be in the cost of the fuel. Consequently, it is unlikely that electricity from atomic energy will be any cheaper than that derived from coal.

Unlike atomic weapons, in nuclear reactors, the liberation of energy must be strictly controlled. It is little use setting up extremely efficient reactors which are likely to explode without warning! On the other hand, nuclear fuel is so expensive that it must be burned economically and the temperature of the reactor must be so maintained that the energy is efficiently converted into electricity.

Three types of reactors are possible, each of which is suitable for particular applications, and in every case economy of operation can be ensured if they are constructed as "breeder" reactors. The three types are: (a) slow reactors, in which the

(1) Thorium 232 + neutron → thorium 233.
(2) Thorium 233 → protoactinium 233 + electron.
(3) Protoactinium 233 → uranium 233 + electron.
(4) Uranium 233 + neutron → 2 nuclei of half the atomic weight of uranium 233 + two or more neutrons + energy.

Figure 3: Schematic representation of the derivation of uranium 233 from thorium 232, and the fission of this material.

neutrons are slowed down by moderators such as water, graphite and beryllium before colliding with the nuclei; (b) intermediate reactors, in which the fission neutrons are slowed down somewhat, but not nearly so much as in (a); (c) fast reactors, where the fission neutrons are not slowed down at all, see Fig. 5.

Both the low-powered Gleep and the high-powered Bepo piles at Harwell and the Windscales piles are of the slow reactor type. They use natural uranium as fuel and are moderated by graphite.

Gleep is capable of running at 100 Kw power output, but is essentially a low-temperature reactor with air cooling and is unsuitable for electricity production. The nuclear fuel consists of 12 tons of natural uranium metal and 21 tons of uranium dioxide, and there are 505 tons of graphite used as a moderator.

The reaction is controlled by cadmium rods, which can be inserted into the pile and absorb the fission neutrons, thus reducing the rate at which fission occurs.

Bepo is of a similar construction and was intended to operate at a

Type of reactor	Material used for "fuel"	Moderator	Uses
Slow	Any fissionable material, not necessarily pure.	Always used.	Experimental purposes and "breeder" work.
Intermediate	Usually "fuel" enriched in fissionable material.	Only sufficient to partially slow down the neutrons.	Small size power plants, i.e., for ships and submarines.
Fast	Primary "fuel" usually pure fissionable material.	None	"Breeder" purposes and power production.

Figure 5: Table summarising the types, characteristics and uses of nuclear reactors.

power of 6000 Kw. It contains a total of 40 tons of uranium, is air cooled, and its maximum operating temperature is 200 deg. C. The reactor proper is in the form of a 26ft cube, but this is surrounded by a massive radiation shield of concrete and steel. Boron carbide rods are used to control the reaction.

Both these piles were meant for experimental purposes and never intended as sources of electric power, although some of the heat is now extracted and used to supply hot water for space-heating some of the laboratory buildings.

Some reduction in the size of the reactor can be achieved by using uranium enriched in uranium 235 or by using uranium 233 or plutonium 239. Such units would, however, be very wasteful of fuel since they would not be breeder reactors and their use will, no doubt, be confined to special applications, such as ship, submarine or aircraft propulsion, where their small size would be a decided advantage.

INTERMEDIATE TYPES

There has been no indication that any reactors of this type are to be built in this country, though one is under construction in America. This is known as the Submarine Intermediate Reactor and, as its name implies, it is intended as a power unit for a submarine.

The advantages of this type of reactor over the slow neutron types are that it will be smaller in size and be capable of running for longer periods of time without refuelling. It is proposed to use uranium enriched in uranium 235 as a fuel and to extract the heat with molten sodium metal as a coolant. The heat thus extracted will be used to liberate steam which will drive a turbine and turbo-generator. Beryllium is to be used as a moderator for the fission neutrons.

This type of reactor is usually of the "breeder" type and the proposed new power generator at Dounreay in Caithness will be the first to be developed in Britain.

The primary fuel will be plutonium 239 or uranium 235, and this will be confined in a small central core round which a liquid metal coolant will be circulated.

This primary fuel zone will be surrounded by a shell of the material to be transmuted, viz., natural uranium or thorium 232 and into which high-velocity fission neutrons will be projected from the core.

When the reactor is brought into operation the material from the shell will be removed from time to time so that the new fissionable material can be extracted therefrom and stored away.

MORE UNSTABLE

Obviously, because of its compactness, inaccessibility of the primary fuel and the absence of moderators, this type of reactor is more unstable than the other types, for if the coolant should stop circulating the temperature would rise rapidly and the reaction might get out of hand. Presumably this is why the reactor is to be built in a remote site.

This slight hazard of reactor instability is more than offset by the improved efficiency of this type of reactor over the other two.

Some fast reactors use a liquid coolant which is circulated throughout the primary fuel, thus bringing about a better transfer of heat.

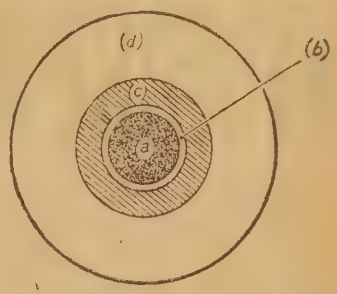

Figure 4: Idealised construction of a "breeder" reactor.
(a) Core of primary fuel.
(b) Coolant and/or moderator which envelops the reactor core.
(c) Shell of material for transmutation into secondary fuel by neutrons from primary fuel.
(d) Radiation shield.

The development of atomic energy reactors has only been achieved after many technical problems have been overcome. New materials have had to be found which would withstand continuous bombardment of all types of nuclear radiations and particles.

It will be recalled that in some types of reactors, particularly those which use natural uranium as fuel, it is necessary to slow the fission neutrons, and to do this effectively moderators are used in which the neutrons are slowed down without absorption.

Very few materials are suitable and those that are have to be prepared in a high state of purity; for small amounts of other materials can absorb a high percentage of neutrons. Graphite, heavy water and beryllium are three of the most widely used moderators.

(Continued on Page 19)

Clouds above and below as seen from an airliner. They are part of a vast heat cycle going on all the time in the atmosphere.

ATMOSPHERE IS A VAST ENGINE

Scientists have for many years likened the atmosphere to a heat engine which consists of a boiler, a condenser, a working substance and a flywheel. This heat engine is a source of vast energy which powers the wind systems off the earth.

by Calvin Walters

THE enormous power of this heat engine can be realised when it is considered that during the brief existence of a hurricane it uses up a much greater energy than 30,000 atom-bombs. Yet a hurricane is only a single disturbance in the atmosphere and is occurring simultaneously with a great number of others such as storms, cyclones and the upper atmosphere jet streams of the higher latitudes of the earth

The power inherent in winds is very great. A wind at a velocity of one mile per hour exerts a pressure of .005 pounds per square foot, but this pressure varies approximately as the square of the velocity. This means that if on a square board of one foot surface area exposed to a wind there be a pressure of one pound, a wind of double the velocity will exert a force of four pounds.

TREMENDOUS PRESSURE

The result of this is that while a wind velocity of one mile per hour exerts a pressure of only .005 pounds per square foot, an 80-mile-an-hour wind exerts a force of about 31lb and a 100-mile-an-hour hurricane exerts a pressure of about 50lb per square foot.

It can easily be seen therefore why winds of such high velocity are so destructive. A 100-mile-an-hour hurricane blowing against a wall 30ft by 10ft exerts a total force of some 15,000lb or nearly seven tons.

Some years ago, Sir Napier Shaw, Professor of Meteorology at the Royal College of Science, calculated the kinetic energy of a small low pressure weather system which caused great damage to the 1917 summer offensive of the Allies in World War I.

He calculated that the energy stored in the system was such as to run 6-million horsepower for a year. Working further from this calculation he assessed the total kinetic energy of the atmosphere at about 18-billion horsepower at any one time.

This is a vast amount of energy, and it is interesting to study just how it is produced by the atmospheric heat engine.

The atmosphere is divided into three sections, namely the troposphere, the tropopause and the stratosphere.

These three layers occur between the surface of the earth and a height of approximately 10 or 11 miles.

The tropopause is not actually a layer but more of a line of demarcation between the troposphere, that is the lower layer, and the upper layer, or stratosphere.

TEMPERATURE EFFECTS

The tropopause varies in height according to the latitude and the weather. It slopes upwards toward the equator and downwards from the equator to the poles, so that its greatest height above the earth is at the equator. Its height may vary by as much as 10,000ft between its lowest and highest part. It also has a local slope downwards toward the centres of cyclonic storms and upwards toward the maximum of high pressure systems.

The air in the troposphere is thoroughly mixed so that the proportions of the various gases are invariable but there is a difference to the mixing which may take place in a laboratory.

In the latter, mechanical mixing can be aided by temperature so that there is an equalisation both chemically and thermally.

In the mixing of the atmosphere, although there is brought about a uniformity of gaseous composition there is no uniformity of temperature or water vapor content.

The result of this mixing is to warm the lower part of the atmosphere and to cool the upper part. When this process is carried on long enough there is condensation of the water vapor with the formation of clouds and rain.

BALANCE UPSET

Nature is continually attempting to maintain a balance both as regards temperature and chemical composition, but is always prevented by the constant supply of heat and evaporated water at the surface of the land.

Instead of maintaining a balance, therefore, there is continuous warming of the air, evaporation of water on the land surfaces, local irregu-

larities of temperature and water condensation, which is subsequently removed by rain.

These local irregularities are also the cause of the various winds which blow on different parts of the globe.

To follow our analogy of a heat engine as applied to the atmosphere, we find then that the boiler is the part of the land surface which is made hotter than the atmosphere by the sun's rays. Parts of the atmosphere can also act as a boiler by being heated by radiation of heat from the earth.

The condenser of the engine consists of those parts of the land surfaces and oceans which are cooler than the overlying air and also those parts of the atmosphere which lose heat by radiation.

The working substance of the heat engine is the troposphere. Here the vast variations of temperatures and the continual condensation of water vapor into rain provide the energy for driving the fly-wheel, which is the great wind systems of the globe.

The boiler is most efficient in the regions of tropical seas for here we find the greatest rate of evaporation. The energy of the engine is derived from the latent heat stored in the water vapor.

TRADE WINDS

The invisible water vapor is carried up to high altitudes and carried by the trade winds far away from where the vapor is generated.

The energy of the water vapor is released as heat when it reaches regions where the conditions are ideal to act as a condenser. Here the heat generates conditions which are conducive to the formations of winds which in turn act as the fly-wheel of the engine and are possessed with vast potential energy. The processes by which this kinetic energy is provided is still largely a matter of varying theories, and is a subject too wide for discussion here.

Although it is known that the source of the energy of the atmospheric heat engine is the water vapor from the sub-tropical oceans it has been a matter of conjecture as to how this energy is transported throughout the global atmosphere.

Latest experiments point to those cotton wool type of clouds called cumulus as being responsible for feeding the energy to the atmosphere.

They appear to be a part of the pump which feeds the fuel to the engine. As the water vapor rises from the ocean it is mixed through the air by means of wind eddies. As the vapor rises still further it forms into the fleecy cumulus clouds. If it were not for these clouds the vapor could not rise very high. The cumulus clouds, however, carry the vapor to a few thousand feet and can be likened to a pump in the form of columns of moist, warm air continually rising to heights of from 2000 to 7000 feet.

CLOUD "PUMPS"

Thus enormous quantities of water vapor are transported to high altitudes. Considering the vast areas over which these clouds form, it is evident that they are continually pumping great quantities of energy in the form of latent heat day and night all the year round.

The ocean is known for its tides. What few people realise is that the earth's atmosphere is also subject to tidal movements.

It has been calculated that these pumps are quite capable of pumping all the fuel required to feed the wind systems of the globe. One scientist states that a group of cumulus cloud covering only a quarter square mile in area can quite comfortably transport aloft the same amount of latent energy in water vapor as a 1000 pound TNT bomb exploding once a minute. He also states that, taking into consideration all the areas covered usually by cumulus clouds there is a supply of energy about 50 times greater than is used to provide the kinetic energy in the whole of the wind systems of the earth. What is not used up in this way is radiated out into space.

EARLY SUGGESTIONS

Experiments have recently been conducted into the general behavior of cumulus cloud formations in order to determine if possible several so far unanswered questions such as why cumulus clouds usually occur in clusters with clear sky between. Why do they start to form at a height of about 2000 feet? Why do they cease growing at about 7000 feet? How do they carry moisture upwards. What makes them form at all?

These questions have so far remained unanswered, but it has been found that clouds are continually mixing with the air outside them. Thus it is possible that, as a cumulus cloud rises, it draws into itself air from outside itself, and this air is usually drier than the cloud. But as the driving force of the cloud is the latent heat of the water vapor within it, this drier air may tend to prevent the further growth of the cloud, and thus the average size of most individual clouds are the same. Larger clouds are formed by the merging of a number of smaller ones. A further interesting fact about the atmosphere is that it is subject to the pull of the moon and sun which produce atmospheric tides similar to those produced in the sea.

Newton was the first to suggest that such a phenomenon as atmospheric tides might exist at all. The French astronomer Pierre Laplace attempted to measure these tides 125 years ago but did not meet with great success. This was mainly due to lack of suitable instruments.

Nevertheless recent investigations have revealed that moon and sun

(Continued on Page 19)

Rain is just another part of the atmospheric cycle. One doesn't always appreciate its finer points, however.

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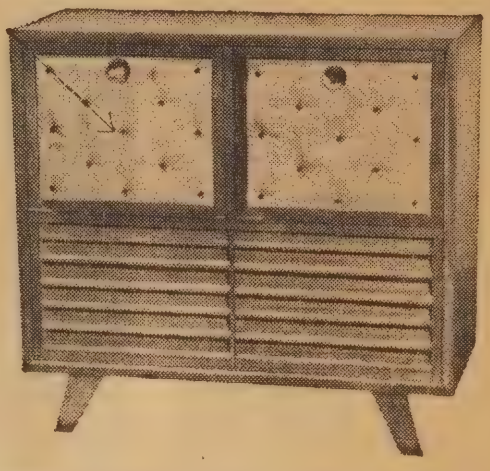

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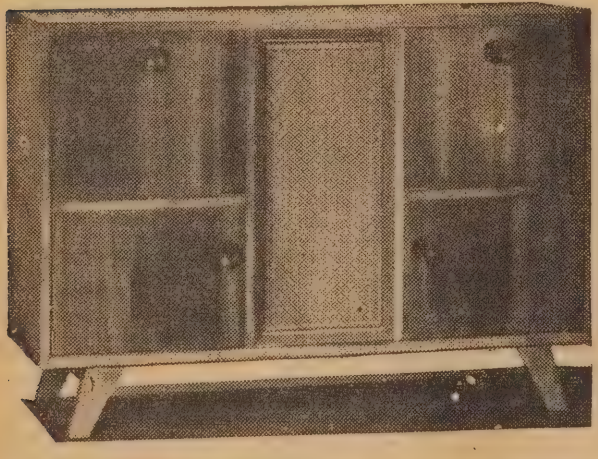

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tides in the atmosphere have some influence on weather. While the rise and fall of the oceans during tidal periods is easily observed from land by height gauges, this method is not possible at sea. The only method available at sea is by means of an instrument on the bottom which registers the varying weight of water due to the rise and fall of the tide.

Practically the same device must be used to register the atmospheric tides for it is not possible to measure the height of the atmosphere with any kind of yard stick.

The barometer thus becomes the instrument used for this purpose, and it has been found that high and low tides in the atmosphere corresponds to higher or lower barometric pressures.

EFFECT ON SUN

These tides are caused partly by the moon, but to a much greater degree by the sun, which is contrary to the position in relation to ocean tides where the moon has a greater influence than the sun.

Recordings of these atmospheric tides are taken in tropical regions for the reason that at any other location the barometer is influenced by normal weather changes consequent to temperature changes and other factors, while the more stable weather conditions in the tropics make for a more constant barometric pressure.

The reason for the sun having a greater influence than the moon on the atmospheric tides is the fact that the atmosphere has a natural period of rise and fall which corresponds with the period of the sun of 12 hours. Air waves created by the sun's heat also have this 12 hour period of vibration. Thus the sun's influence is somewhat magnified and tends to overshadow that of the moon.

The presence of coastlines has a pronounced effect on the tides of the ocean but because of the absence of these in the atmosphere the atmospheric tides are less variable. Certain high mountain chains behave somewhat as the coastlines for oceans but their effect on the atmospheric tides is not of very great importance.

MOON TIDES

While the moon tides are much less than the sun they have a pronounced effect on the ionosphere. This fact makes them easier to detect. Radio waves bounce from the ionosphere which is a layer of ionised air above the earth. By measuring the radio signals as they are bounced from the ionosphere the moon tide can be followed around the earth and the height of the ionosphere measured. It has been found that the moon causes the ionosphere to rise and fall by as much as one mile.

The atmospheric tide also brings about a waxing and waning of the showers of cosmic ray particles which are forever falling upon the earth.

Further investigation of the atmospheric tides promises to reveal more exciting facts for the future.

NUCLEAR REACTORS FOR POWER

(Continued from Page 15)

In most reactors the atomic fuel is "canned", i.e., placed in sealed containers which serve the double purpose of preventing contamination of the fuel or contamination of the cooling medium by the fission products from the fuel and also act as a moderator for the neutrons.

Originally, aluminium in a high state of purity was used for these containers, but this meant that the operating temperature of the reactor could not be very high—usually 200 deg. C. was considered the maximum safe operating temperature. Clearly, this was much too low to enable the reactor to be used as an efficient "boiler" to power a turbo-generator.

USE OF ZIRCONIUM

Much work has gone into the search for suitable moderators and container materials which would allow reactor-operating temperatures in the 500 deg.-800 deg. C. region to be attained. Beryllium has been found suitable here, but it is a dangerous material to handle, being highly poisonous.

The most favored metal for containers today is zirconium, for this is very stable toward bombardment by nuclear particles and can withstand high operating temperatures. But although zirconium is relatively simple to obtain from its ores, it is very difficult to purify, being invariably associated with the element hafnium, which because it is a good absorber of neutrons and would, therefore, lower the efficiency of the reactor must be removed completely.

There is also the problem of efficient heat transfer from the reactor to the turbo-generator. Some reactors which have been built in America use water or heavy water as a coolant, this being circulated through the reactor and a heat exchanger, but these reactors were not really designed for power production. In another reactor of the fast type, called "Clementine", which used pure plutonium as fuel, mercury was employed as a coolant.

But for efficient power production it appears likely that molten metals will be used as coolants, so that temperatures of 500 deg. C. or more will be achieved. These liquid metals, particularly sodium and potassium, can be circulated round a closed circuit into a heat exchanger, using electromagnetic pumps which have no moving parts!

In addition to the careful selection of the materials which make up the reactor proper, the constructional materials have also to be carefully chosen, since the liberation of energy from the atom is invariably accompanied by harmful radiations from which the operator must be fully protected.

A basic factor in reactor design appears to be the heat exchanger, so that the coolant which is circulated through the reactor does not enter the turbo-generator. In this way the harmful radiations are kept away from the power generating equipment. Radiation shields adequate to safeguard the operators are usually made of concrete or lead, or both.

CONTROL METHOD

Another important factor is the method of controlling the reaction, for, unlike in atomic weapons, the reactions that occur in nuclear reactors must at all times be under control. Neutron-absorbing materials are, therefore, an integral part of reactor design and provision has to be made for their automatic insertion and withdrawal from the fissionable material. Cadmium and boron carbide are used for this purpose.

Finally, there is the by no means insignificant problem of the disposal of the waste components of the "burnt" fuel, which are strongly radio-active and harmful to health. Elaborate storage facilities have to be provided for these materials to allow the radio-activity to decay to such an extent that they can be safely disposed of.

THEY EXPLORE THE SUN'S FACE

(Continued from Page 7)

Normally, the theory goes, spicules reinforce the corona at a steady rate. But, when an above-average number of spicules are clustered in a particular region on the sun, and if, at the same time, there are "favorable" distortions of the sun's magnetic field in that area, the corona bulges and a streamer is born.

That the spicules seen as dots in the Rocky Point photographs are the same things seen as long thin spikes in coronagraphs, has been the subject of considerable checking at Rocky Point.

Dr. Miller is now optimistic that this correlation can soon be established: the black dots have roughly the same lifetime (3-4 minutes), the same size (5-6000 miles in diameter, miniscule by solar standards), and the same population density as the spicules seen by others in profile photographs.

Watching spicules along with Dr. Miller are A. B. Moulton and Ralph E. Franklin. Both have been engaged in communications and research engineering with RCA for nearly 35 years, and both boast years of experience as backyard astronomers.

To help in analysis and interpretation of their pictures, the Rocky Point trio are receiving the assistance of Dr. Walter Orr Roberts, Dr. Joseph N. Rush, and other solar experts at the High Altitude Observatory of Harvard and Colorado Universities, at Climax, Colorado, under a contract with RCA Laboratories.

The superlative coronagraphic results obtained at Climax are available for continuing comparison with the "full-face" observations of Rocky Point.

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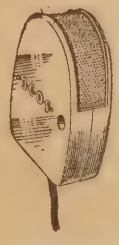

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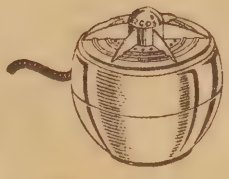

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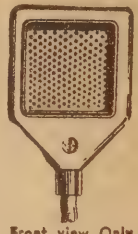

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MIC.3-5	" "	" " " " "	12db " " " "	Mervyn	1 19 3
MIC.3-6	" "	" " " " "	5db " " " "	Myrtle	1 19 3

MIC. 6 SERIES

TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.6-4	General Purpose	2 1-32in dia. x 19-32 thick	20db Peak at 2250 C.P.S.	Margie	£1 19 3
MIC.6-6	" "	" " " " "	5db " " " "	Maudie	1 19 3
MIC.6-11	" "	" " " " "	12db " " " "	Mandy	1 19 3

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TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.14-5	General Purpose	1 7-16 dia. x 11-32in thick	20db Peak at 3500 C.P.S.	Maxie	£1 19. 6
MIC.14-11	" "	" " " " "	12db " " " "	Mitchell	1 19 6
MIC.14-12	" "	" " " " "	5db " " " "	Malcolm	1 19 6
MIC.15	Hearing Aid	0.9in dia. x 0.155in thick	30db " " 3000 "	Marlene	1 19 6
MIC.17	" "	15-16in sq. x 7-32in thick	30db " " 3500 "	Maggie	1 19 6
MIC.18	General Purpose	1 7-16in dia. x 9-32in thick	20db " " " "	Maisie	1 19 6
MIC.19-4	" "	1 ¾in dia x 13-32in thick	Flat from 40 to 6000 CPS	Merry	1 19 6

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MIC.23	General Purpose	1 3-16 sq. x ¼in thick	20db Peak at 3000 C.P.S.	Maureen	£1 19 3
MIC.23-3	" "	" " " " "	5db " " " "	Margaret	1 19 3
MIC.23-4	" "	" " " " "	12db " " " "	Milton	1 19 3
MIC.32	High Quality	1 13-16 dia. x 9-16in thick		Martin	2 15 6

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Technical Review

MACHINES CAN ASSEMBLE NEW TYPE CERAMIC VALVES

A new era in valve assembly methods may be foreshadowed by the evolution of a structure in which ceramic spacers, base and envelope, replace the usual mica and glass components. The new design is adaptable for machine assembly methods, suggesting automatic production of valves.

DEVELOPED by a Division of Sylvania Electric Products Inc., the new approach is described in a recent issue of Electronics, by R. N. Palmer.

The valve selected for adaptation was the military type 6045, which is a ruggedised version of the 6J6 twin triode.

Chief bar to successful machine assembly of ordinary valves has been the manipulation of the mica spacers, particularly the one at the top, which has to be fitted simultaneously over several support rods protruding from the electrode structure.

In the standard 6J6 twelve such insertions have to be made before the mica will slip into position.

The difficulty has been overcome in the new method of assembly by stacking the elements one upon the other, with ceramic spacers in between of the required dimensions. The complete unit is assembled on two small pins.

ORDER OF ASSEMBLY

First, a plate goes on, then a ceramic spacer, a grid, a spacer, a cathode, another spacer and so on, until the top of the pin is reached.

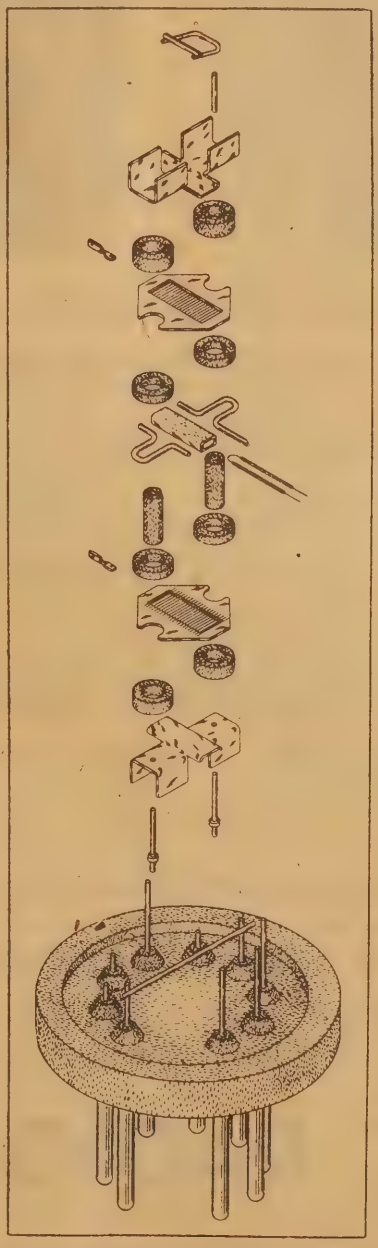
The structure is then pressed and locked in position, giving a tight and rigid assembly, which can be connected as necessary to the remaining base pins.

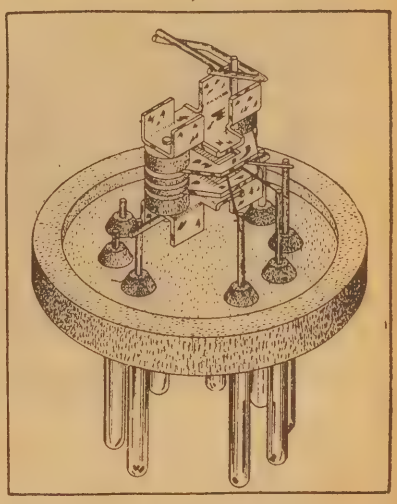
The method of support lends excellent rigidity to the whole structure, ensuring low microphony and good resistance to shock and vibration.

Element spacing, which is the critical dimension, is entirely dependent on the dimensions of the spacing washers. These may held to very close tolerances or varied at will if different characteristics are required.

The exclusive use of ceramic spacers makes it possible to seal and finish the valve at temperatures which would rupture mica and melt glass.

It is thus possible to use a ceramic base stem and envelope, which are sealed together using a special titanium cored solder, at a temperature of about 900 degrees centigrade.





A sketch of a twin triode assembled on its ceramic base stem and ready for sealing into a ceramic cover. At left, an exploded view.

This high baking and sealing temperature, as well as the exclusion of mica from the structure, ensures a greater than usual freedom from gas troubles during life.

Individual elements within the new valve differ markedly from the usual type.

The conventional cathode sleeve is supported only at the ends, where it passes through holes in the mica support plates. These holes have to be made deliberately oversize to facilitate assembly and are further enlarged during life by the sawing action as the cathode expands and contracts with use. Only about 60 pc of the total surface can provide useful emission.

HEAVY SUPPORTS

The new type cathode sleeve is supported wholly within the confines of the electrode structure, by stout loops welded to its sides.

Instead of a spiral, supported down the sides of rods, the new type grid is a pattern of wires stretched across a flat molybdenum plate and brazed into position with gold.

The wires can be assembled under

(Continued on Page 25)

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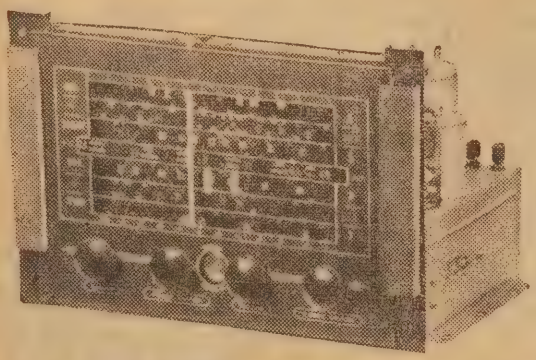

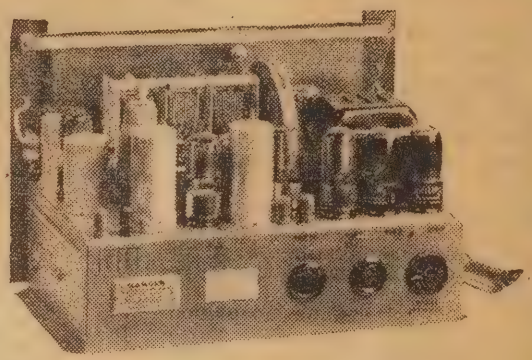

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NEW EYE CAN SEE ONE 10-MILLIONTH OF AN INCH

A new type of electron microscope, twice as powerful as any now in use, will go to work very shortly to help science probe more deeply than ever before into the nature of cancer.

THE first of the new instruments, developed and built by RCA, made its public debut at the United Nations, New York, in ceremonies at which it was turned over to the world-renowned Karolinska Institute of Stockholm, Sweden.

With the new microscope, scientists will be able to study particles smaller than one 10-millionth of an inch in diameter. Photographs are taken by automatic cameras built into the slender pylon that houses the electron source and the images may be enlarged consistently up to 200,000 times the size of the specimen—a scale at which a small coin would measure more than two miles across.

By comparison, the previous type of electric microscope, with which the polio virus was first observed, normally provides useful photographic enlargements only up to 100,000 times, although greater enlargements have been achieved by a relative handful of highly-skilled microscopists.

VITALLY IMPORTANT

Mr. Thorsing, Sweden's UN delegate, accepting the microscope, read a letter from Dr. Fritioff S. Sjostrand, head of the Karolinska Institute, in which the Swedish scientist described the electron microscope as one of "the most important technical instruments" in medical and biological research. Their use, he said, has helped to give scientists a fuller knowledge of the "most fundamental character of the life process".

Dr. Sjostrand indicated in his letter that the powerful new microscope will first be put to work to widen the scope of information about the construction of normal cells in order to shed greater light on the nature of those which develop abnormally, as in cancer.

"This work is now on foot and our earlier conceptions of the cell structure have already been greatly modified," he wrote. "Only when sufficient observations have been made regarding normal cells, e.g., cells of the nervous system, of the sense organs and the glands, can the study of pathologically transformed cells, such as the cancer cells, be expected to produce reliable results."

NEW UNDERSTANDING

"There is hope that the analysis by electron miscrocopes will lead to discoveries which may cast light over the character of the cancerous process and thereby provide a clue to the understanding of the cancer disease."

In appearance, the new microscope differs radically from earlier types. Two desk-type working surfaces, each backed by a sloping control panel, flank a slender 7½ft vacuum column that forms the heart of the instrument. The desk and control panel units are joined to the column at a slight forward angle to place all controls within reach of the operator, seated on a chair in the centre.

Built in the column at desk level is a viewing chamber equipped with windows on three sides to permit several persons to see the enlarged specimens at the same time.

Magnification up to 30,000 times is obtained on the direct viewing screen, while enlargements up to 200,000 or more times is achieved from photographs taken by automatic plate and roll film cameras housed in the column.

The new microscope operates on the same principles as its less powerful predecessors. A concentrated beam of electrons, originating from an electron gun, is directed through the specimens to be observed. As the electrons pass through the specimen, they are affected in varying degrees according to the density and composition of its various parts.

☆

(Right) Oscar Thorsing, Swedish delegate to the United Nations, listens as T. A. Smith, Vice-President in charge, RCA Engineering Products Division, explains operation of the new electron microscope.

☆

(Below) The first micrograph made with the new microscope shows a minute section of muscle fibre magnified 100,000 times. Much larger degrees of magnification can be obtained consistently, where necessary.

When the beam emerges from the far side, it bears the pattern or "image" of the specimen, which is then magnified by powerful magnetic lenses that act upon electron beams very much as glass lenses act upon light. The pattern finally is projected upon the viewing screen.

The ordinary optical microscope, using light to form the image of the specimen, is limited in its range by the wave-length of visible light. Objects appreciably smaller than this wave-length fail to interrupt or reflect the light in any visible fashion.

SIMPLER OPERATION

Dr. Robert G. Picard, manager of Scientific Instruments Engineering, RCA Engineering Products Division, who designed the new instrument, told the UN audience that the basic objective of the new design was to make operation so simple that people without specialised training can operate it successfully. The improved features that have contributed to this objective are:—

1. Push-button control of practically all operations, including photography.
2. A 30 pc increase in resolving power—the ability to distinguish separate particles clearly at the outer limits of magnification.
3. Provision of controls that allow the operator to correct astigmatism easily while watching the image—a process that has involved much time and manipulation in previous models.
4. A new power supply, producing either 50,000 or 100,000 volts and giving the electrons higher energy to penetrate thick specimens.
5. Stability in the electron gun, described by Dr. Picard as "an achievement which turned out to be the most difficult single engineering development."

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"SILENT" SPEAKERS PRODUCE SOUND IN FREE SPACE

Recent experiments in France have demonstrated the feasibility of producing audible signals in the free space between two speakers—both operating at frequencies outside the normal range of hearing.

A British version of the Ionophone speaker, as demonstrated recently in the U.S

THE accomplishment was reported by Siegfried Klein, inventor of the Ionophone, in a paper published in the January issue of the Annales des Telecommunications.

The sound is produced only when the two speakers face each other an integral number of half-waves apart. It is strongest in the vicinity of the nodes and loops of the standing-wave pattern between the speakers.

Musicians are familiar with beats between two sound waves of nearly the same frequency, and radiomen know that the superheterodyne receiver works because of similar beats between two RF waves.

BEATING EFFECTS

As in the radio circuit, the sound beats occur at a rate between the two waves.

If two ultrasonic waves beat together at an audible rate, only the beat frequency can be audible. Two Ionophones, operating 2000 cycles apart, were used to produce the sound-in-space effects.

The Ionophone is a true molecular speaker, and works better as the frequency is increased.

As illustrated in the photo, it is a small quartz glass exponential horn, approximately 2in long. Its larger end is butted smoothly to the small end of a larger horn, which continues the exponential curve to make the unit look like an ordinary tweeter.

The smaller end of the Ionophone is just large enough to admit a fine platinum wire. Radio-frequency energy (at about 27 Mc) applied to this wire causes it to ionise the air around it, producing a pink glow in the "throat" of the horn.

When the RF current is modulated by speech or music, the varying ionisation sets up pressures in the air as would a moving diaphragm. These variations in pressure are heard as sound.

As a generator of ultrasonics, the Ionophone approaches the ideal, though probably its results in the sound-from-space experiment might be reproduced with a magnetostriction transducer or possibly even with one of the new capacitance tweeters, which also become more efficient as they leave the audio range.

Two Ionophones are mounted 4 to 6in apart, pointing directly at each other. In the first experiments, one was excited at 30,000 cycles (30 Kc) and the other at 32 Kc.

The distance between the speakers is varied slightly to bring them to an integral number of half-wavelengths apart. (The adjustment is approximate, may be calculated at 30 or 32 Kc or some point between them, and is best made by experiment.)

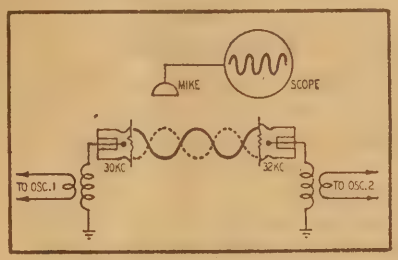

Fig. 1. Microphone and scope are used to explore area where sound is produced.

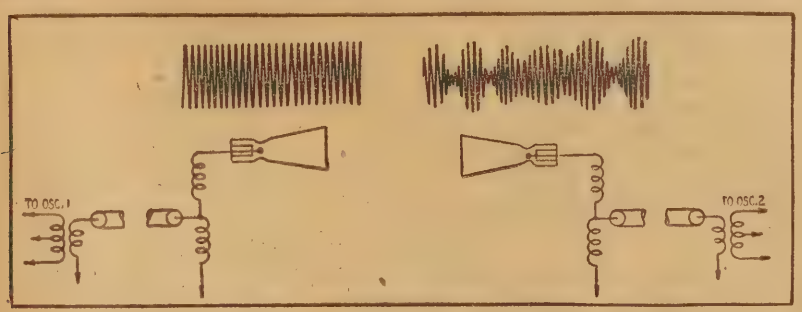

Fig. 2. Experimental setup for modulation with speech and music frequencies.

At the correct point, a 2000-cycle beat note is heard coming from the space between the two loudspeakers.

To prove that the sound is not subjective, a microphone and an oscilloscope may be used as in Fig. 1 to pick up the sound. If one of the signals is modulated, as shown in Fig. 2, the 2000-cycle output note is modulated correspondingly.

In the experiments, reproduction fell short of perfection. One of the bugs was intrusion of the beat-note "carrier".

Further work is being undertaken, in which the speaker frequencies will be above 50 Kc and far enough apart in frequency that the beat-note will itself be ultrasonic. Then only the modulation will be audible.

At present, work is in the purely experimental stages—much at the point the Ionophone was when first reported in late 1951.

Enough has been learned, however, to foreshadow the possible development of an entirely new type of loudspeaker. It would have no moving parts—because of the Ionophone and ultrasonics—and possibly with a new method of reproducing bass notes by frequency—modulating one of the waves so that the wavelength (and, therefore, the amplitude of the standing-wave pattern and the sound produced by that pattern) is varied accordingly.

MACHINES CAN ASSEMBLE NEW TYPE CERAMIC VALVES

(Continued from Page 21)

tension and there is little chance of the structure being distorted either by handling or by heating effects during manufacture.

This is reflected in a much lower spread of mutual conductance during manufacture as compared with equivalent batches of ordinary glass valves.

The greater freedom from gas is emphasised by the ability of the valves to operate for lengthy periods with the plate at the same temperature as the cathode.

Externally, the valves are very rugged. They can be used with sockets or strapped to the chassis and wires soldered, without risk, direct to the pins. They will not break when dropped and have withstood rapid successive immersion in liquid nitrogen and boiling water. They have also been cycled without damage from room temperature to 450 degrees C in a furnace.

In the footmen's room at Windsor Castle there is a specimen of what is known as an "Act of Parliament Clock". Pitt caused a tax to be placed on watches and as a consequence they were seldom worn. Tavern-keepers adopted a bold mural timepiece for the benefit of their customers. These timepieces were called "Act of Parliament clocks".

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NEW A.R.R.2 RECEIVERS
A VHF receiver, 230 to 258 Megs, and 6 channels on broadcast band. Ideal conversion to carset and for hams. A ready-made, double conversion VHF receiver. 10 miniature valves, smaller than average carset. Including photostat of circuit.
PRICE £11/17/6

ZB2/A.R.R.1 RECEIVER
Similar to HF section of ARR2 4 acorn valves
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COMMAND EQUIPMENT

TX	4 — 5.3 mcs complete with xtal	£6/17/6
	5.3 — 7.0 mcs and valves	
RX	6 — 9 mcs	
TX	4 — 5.3 mcs less valves and xtal	£3/-/-
	5.3 — 7.0 mcs	
	7.0 — 9.1 mcs	
RX	190 — 550 kcs complete with valves	£9/17/6

Modulator with valves, £2/12/6. Less valves, 25/-.

BENDIX
BC221 FREQUENCY METERS, AIR TESTED
Original Crystal and Calibration Book
£45/-/-
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£37/10/-

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Automatic or keyed hand generators.
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Ideal for noise limiter, detector, etc.
Wire in like a resistor.
7/6

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EVENINGS and WEEKENDS: "KALUA", COLLAROY ST., COLLAROY—XW5956

AR8 Communications Receiver

6-band 140 to 20 megs 11 valve. Standard octal series. Complete with valves and circuit.

£23/17/6

Completely converted for 240v AC. Built into plastic-covered cabinet latest noise limiter. Added 2 oval-tone speakers. Re-aligned. Tested. Guaranteed Perfect order **£34/17/6**

New Valves

7193	7/6	2050	£1
6H6	7/6	809	£2
6SH7	7/6	717A	12/6
813	£3	6SL7	12/6
807	£1	6N7	10/-
12SH7	7/6	5V4G	12/6
12A6	12/6	828	£3
12SL7	12/6	100TH	£3
12SJ7	12/6	6AJ5	12/6
12SK7	12/6	12SN7	12/6
9001	10/-	6Y6	17/6
6SN7	12/6	12SR7	12/6
6C4	12/6	38	12/6
6AG5	12/6	1J6	12/6
1K5	3/6	1K6	12/6
VR65A	3/6	CL4	10/-
957	10/-	1G4	12/6
1P5	12/6	1LH4	12/6
812	£3	6AM6	17/6
12H6	7/6	6AM5	15/-
6SK7	12/6	10	15/-
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6SA7	12/6	3D6	10/-
6AC7	12/6	3A4	15/-
47	12/6	4307A	10/-
39/44	10/-	RK75	10/-
1C6	12/6	1V	12/6
AZ1	10/-	46	10/-
1LN5	12/6	AF3	12/6
1R4	12/6	ECH3	12/6
1625	£1	15E	10/-
843	£1/10/-	1619	£1
6J6	15/-	1626	10/-
6AG7	15/-	1629	10/-
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NEW SPECIAL SENSITIVE RELAY

10,000 ohm. Operates on .4ma. Will operate Burglar alarm, door openers, etc. Price **£1/5/-**

COMPASS SPIRIT-FILLED 4in NAVIGATION UNITS

New Precision Units .. .. **17'6**

Postage: NSW 3/-, Interstate 5/-

New Coils & Intermediates Standard or miniature to suit all valves.

Coils B/C 455 KC	7/6
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Inters	9/6
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20 WATTS 25, 36, 50, 10,000 OHMS
40 WATTS 850, 6000 OHMS 2/6 EACH
IRC 1% WIRE WOUND RESISTORS
20K, 30K, .15m, .2m, .25m, .5m, 1.0m, ... **7/6 each**

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VCR 97. 47/6

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Specially suitable for TV experiments. Socket, connections supplied.

OIL-FILLED CONDENSERS

8uf 500v 10/-	8+5uf 500v 10/-
4uf 500v 7/6	1uf 600v 6/6
4uf 600v 7/6	2uf 400v 6/6
2uf 2000v 12/6	1uf 7500v £1/5/-

RELAYS

200 ohm	7/6
500 x 500 ohm	12/6
10,000 ohm DPDT	£1/-/-
12 volt DPDT 5 amp	£1/-/-
24 volt DPDT	12/6
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Aerial change over. Shielded	18/6
AWA 12 volt	£1/-/-
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Throat Mikes, new	3/6
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Hi-Lo Phone Transformers	4/6
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6v-550v 160mA	£6/10/-
12v-550v 350ma	£6/10/-
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12v 500 watts	£3/-/-
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1500 x 1500, 750ma	£10/10/-
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365 x 365, 150ma	£2/5/-
400ma Chokes	£2/10/-
150ma Chokes	£1/2/6
650ma Chokes	£3/10/-

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...Deliver the GOODS!

Four Brilliant Newcomers to the Popular PHILIPS MICROPHONE RANGE!

On the water! . . . for release EARLY in JANUARY, four brilliant imported newcomers to further expand the already selective Philips microphone range! And without doubt . . . they're well worth waiting for! Philips once again are delivering the GOODS!

the GOODS in QUALITY...

The superior craftsmanship evident in both design and precision finish of every individual component in these new Philips microphones is obvious at first glance! Every effort has been made to combine robust construction with lightness and still maintain eye-pleasing design.

the GOODS in VALUE...

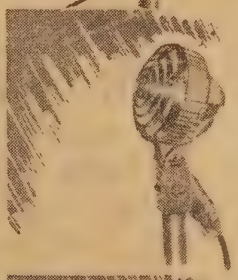
In spite of the fact that these microphones rank in quality with those being offered at double and even treble their price, the overwhelming demand created throughout the entire world has enabled Philips to produce them in such quantities that the highest standards of quality are offered at such a low price!

the GOODS in PERFORMANCE...

In these four new microphones Philips have provided a complete coverage of every microphone application ranging from simple Public Address work to the most exacting requirements of Studio and professional use.

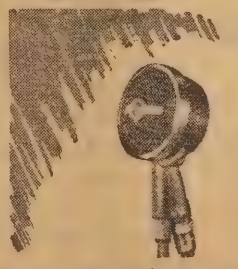
Prices and illustrated leaflets on application to . . .

Type No. EL6040. The most outstanding microphone in the entire range! The "pencil" microphone has a frequency response which is substantially flat from 50 to 15,000 CPS. The exceptional combination of optimum reproductive quality and great mechanical strength opens up quite new possibilities in the public address field . . . broadcasting . . . television . . . and film recordings.



Type EL6030. A hyper-cardioid moving coil microphone. This unidirectional, very sensitive, high quality microphone enables the gain of the amplifier to be increased considerably without risk of acoustic feed-back! Reproduction of ambient noise is so weak that for the same effect the normal speaking distance can be doubled. Tropic rain and dust-proofed.

Type EL6020. Non-directional, electro dynamic microphone admirably suitable for high quality sound recording as well as broadcasting use. Due to special design, it is exceptionally efficient where group recordings are being made.



Type No. 9549. A moderately priced extremely robust microphone for general purpose work where reproduction of both speech and music are required. Can be employed just as efficiently in the open air as in enclosed spaces. Equipped with durable plastic diaphragm . . . tropic-proofed. Output impedances: at 10,000 ohms, 2.4 mV. 500 ohms, 6 mV. 200 ohms, .4 mV.

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NEWS AND VIEWS OF THE MONTH

Electronic brain

THE long-range weapons establishment at Salisbury, South Australia, has installed a new electronic brain, according to the Minister for Supply (Mr. Beale).

The brain would help develop radar, gunnery systems, guided missiles, and high speed aircraft, he said.

It was the biggest calculating machine of its kind in the southern hemisphere.

The machine could trace high-speed aircraft and guided missiles and calculate their speed, direction and the height.

British scientists, meanwhile, have evolved a new calculator which enables them to re-enact in miniature what happens when a fighter chases a jet bomber through the stratosphere.

The machine covers 6000 square feet of floor space and uses enough electricity to light a small town.

It contains 8000 valves and is controlled with 2000 knobs.

Its output will be equivalent to 10,000 girls working calculating machines.

It cost £750,000 to instal at the Royal Aircraft establishment at Farnborough.

★ ★ ★

Noise problem

WITH the ever-increasing power of aircraft engines, the problem of the noise made by engines undergoing test has become more acute. Inconvenience to the public and to factory staffs have made it necessary for intensive research work to be undertaken. A considerable degree of success has been achieved, and a British company, Vickers-Armstrongs Ltd., has just revealed one of the results of this effort.

It is in the form of a pen, with sound-proofed walls, into which the aircraft is inserted when running-up the engine. The end of the jet efflux pipe of the engine is positioned in front of a "muffler" like those used to silence the test beds of engine manufacturers.

Before the completion of the new pen, whenever the Rolls-Royce Avon engine of a Swift fighter was being run at full throttle, using reheat, conversation was virtually impossible in the factory offices a quarter of a mile away. Now, with the pen in use, most of the office staff do not even know when an engine is being tested.

The walls of the pen are about 12½ feet high, and they completely enclose the aircraft on test on three sides. The fourth side is made up of two sliding doors, made of steel —but lined with sound-proofing material. In the wall opposite the doors, there is an opening for the "muffler", aligned so that it is opposite the end of the Swift's jet pipe. The total length of the "muffler" is about 45ft. It consists of a metal tube of increasing diameter filled with a large number of baffle plates.

The side walls of the pen accommodate shelters in which the maintenance crews can watch the aircraft under test while sheltered from the weather.

Atomic power

DESPITE abundant power resources Australia already had need for nuclear power stations, according to Professor Titterton, Professor of Nuclear Physics at the National University, Canberra.

He said nuclear power stations were necessary to save long haulage of conventional fuels to isolated centres like Kalgoorlie and Broken Hill.

A single charge of reactive material could last 10 or 20 years on present indications.

While in Britain Professor Titterton examined a 50,000,000 watt atomic power station being erected at Colder Hall (Cumberland).

The power station would begin pumping its output into the national power grid in about two years.

The station would then represent the first big industrial use of atomic power in the world.

It expected to produce power at 1d a unit.

Professor Titterton said he visited Britain's Harwell Atomic Energy Research establishment.

"Research is going on there at an astounding pace," he said.

"There is little doubt that Britain leads the world in pure atomic research.

"Her scientists were the first to discover mesons, an 'atomic glue' which holds the atom nucleus together.

"What they have done there is directly linked with special lines of research into atomic nucleus at Canberra."

POPULAR SCIENCE QUIZ

Q. How is color photography replacing certain industrial blueprints?

A. According to recent information, the Bell Aircraft Corporation in USA are using color pictures to replace the blueprint to assist in speedier construction of complex electronic equipment.

The use of these pictures eliminate the long study of "difficult" blueprints and which is often supplemented by a visit to an actual working model. The display in color of the innards of a piece of equipment being manufactured allows a relatively untrained operator on an assembly line to see immediately where to solder, say, the green wires, how to bend the red wires and where a run of wires should be laced together.

It is believed that the use of the pictures will "substantially reduce" the need for reams of blueprints in the manufacture of a new piece of equipment. It is also claimed that the general circuitry becomes clearer in the mind of the operator leading him to a better understanding of the function of each wire.

The pictures are taken on a color film which is developed to produce a color "negative" instead of the usual positive transparency as required for home movie or color slides. Any number of positive prints can be made from this negative to allow each operator to have his or her own copy.

Q. Does life at high altitude affect sea-level birds?

A. Tests carried out by the University of California indicate that turkeys, as representative sea-level birds, suffer no ill-effects from existence at an altitude of about two miles.

Day-old chicks, hatched at just above sea-level, were taken to a mountain station at 10,500 feet above sea-level and their growth compared with similar stock being reared at sea-level. No interference with their growth or attainment of sexual maturity was noticed. The only reported change was an increase in the size of the heart. The birds did not show the increases in lung or spleen size that has been observed in mammals raised under similar conditions.

Q. What is an important sign of impending heat stroke?

A. Doctors have found that the most important warning sign of impending heat stroke is the sudden cessation of sweating Heat stroke involves part of the brain called the hypothalamus which is associated with the function of perspiration.

It is recommended that if the warning sign is observed the person be bedded made as cool as possible and urged to drink plenty of water. If sweating does not soon reappear call a doctor.

Heat stroke is more serious than heat cramps or heat exhaustion. "Sunstroke" may be either heat exhaustion or heat stroke. Symptoms of heat stroke include headache, red face, hot, dry skin with no sweating, strong and rapid pulse, very high body temperature and usually unconsciousness. Symptoms of heat exhaustion include pale face, moist, cool skin with profuse sweating, weak pulse, low temperature and sometimes nausea, vomiting and giddiness.

Treatment for heat stroke is to make the person as cool as possible by removal to bed or to a shady spot, sprinkling with water and removal of most of his clothes. In contrast, treatment for heat exhaustion is to make the patient warm by covering with a blanket and to administer such stimulants as warm tea or coffee, or smelling salts.

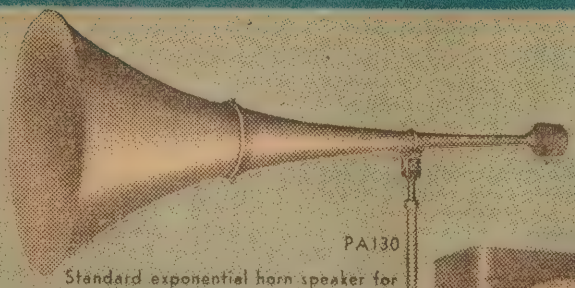
SWITCH TO AWA

PUBLIC ADDRESS SPEAKERS

THE MOST COMPREHENSIVE RANGE OF SPEAKER ASSEMBLIES FOR EVERY REQUIREMENT.

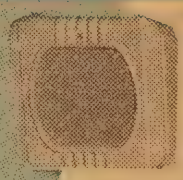
PA138

Standard reflex horn speaker for medium distance projection of speech and incidental music.



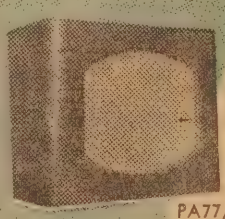
PA130

Standard exponential horn speaker for public address where distance projection of speech and incidental music is required.



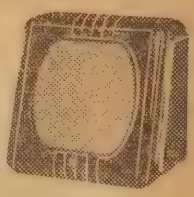
PA150/I

Attractive moulded ivory cabinet with 7" cone speaker and 600 ohm line transformer. Suitable for wall or desk mounting



PA77/12PS

Polished timber cabinet for wall or table mounting with 12" cone speaker and 600 ohm line transformer.

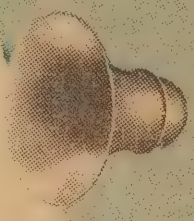


PA150/W

Moulded walnut speaker, similar to above. These models are also available with 600 ohm stepped faders.

RESLO DRIVE UNITS: SU10 & SU12

Exclusive features are the self-locating diaphragm and the concentrically interlocked magnet which together produce an undisplaceable mechanical assembly, proof against decentering.

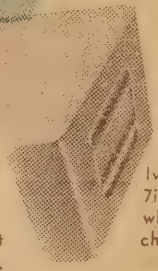


PA108 & PA109

These flare baffles are for use with 7in and 12in permanent magnet cone speaker units and provide high conversion efficiency.

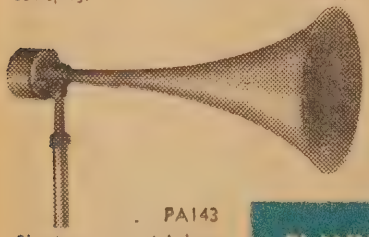
PA118

Pendant type, ceiling suspension, 360° diffusion speaker suitable for distribution of voice and music.



PA73

Ivory timber cabinet with 7in speaker for applications where a bi-directional characteristic is desired.

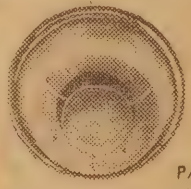


PA143

Short exponential horn speaker for distance projection of speech only.

PA177

Flush, ceiling mount 360° diffusion reproducer with 7" cone speaker. Can be colour matched to suit any background.



PA178

Surface mount reproducer similar to PA177, for use where flush fitting is not practicable.

PLANNED FOR OPTIMUM FAITHFULNESS OF SOUND REPRODUCTION, IN KEEPING WITH PHYSICAL AND COST REQUIREMENTS, IN STYLES AND FINISHES TO SUIT ANY BACKGROUND OR CIRCUMSTANCE OF USE.

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New speed barrier

A NEW barrier, which may prove a killer unless a way to circumvent it is found, has emerged in man's effort to fly faster according to scientists who attended a three-day conference at Zurich.

The scientists said infra-sonorous vibrations, radiating from the latest jet engines, formed the barrier.

Unless something was done to cut down the vibrations man might be thwarted in his flying efforts.

The scientists cited examples of "sudden and excessive mental and physical fatigue" that befell pilots flying experimental "aircraft of tomorrow."

The same vibrations, from a special siren in a laboratory test arranged for the scientists killed rats.

The fact that shaved rats died quicker than unshaved hats provided the experts with a hint of a possible answer to the problem.

The delegates agreed it "might be possible" that the vibrations would not penetrate some special type of protective clothing.

The scientists were shown a gadget which checked, from the ground, the heartbeats of a pilot in flight.

The machines will enable the various air forces to weed out pilots whose hearts cannot stand the strain of flying a supersonic jet in the modern age combat.

★ ★ ★

New planes

THE Australian navy will re-equip three Fleet Air Arm squadrons with modern planes next year.

The re-equipment will strengthen Australia's defences against submarine attack.

This was stated by the Minister for the Navy (Mr. Francis), who recently announced the navy's plans.

He said the new planes were now going into service in Britain.

Mr. Francis said the Government would re-equip two squadrons with Gannets and the third with Sea Venoms.

The Gannet was a comparatively large turbo-prop plane, designed for anti-submarine duties. It contained the most modern device to detect submarines.

The Sea Venom, a turbo jet fighter, could fly in any weather.

Mr. Francis said a program to replace Sea Fury fighters and Firefly anti-submarine planes in other squadrons would follow.

★ ★ ★

Lecture by phone

PEOPLE fearing they may have cancer but afraid to see a doctor soon will be able to hear recorded talks on cancer by telephone.

The Hull Corporation will operate the service, but anybody in Britain will be able to dial the Hull number and hear the talks.

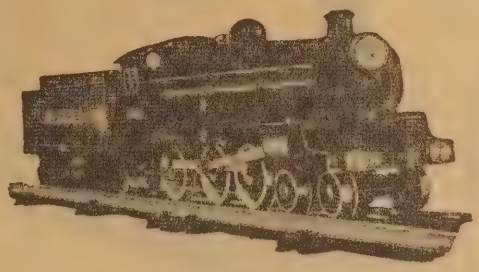
The Marie Curie Foundation for Cancer Education is sponsoring the program.

A Corporation official said yesterday: "The service will be able to handle 300 calls at a time.

"The talks will give details of the symptoms in some cases and advice on what to do."

Accurately Engineered

FERRIS Electric TRAINS



and

Accessories

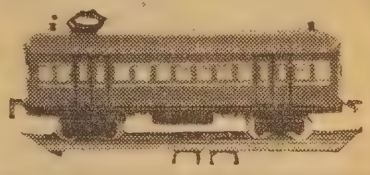
Ferris electric Trains and Accessories are accurately engineered just like the Real Ones. So realistic in every way.

MODEL F51—LOCO AND TENDER . . . £12/3/-

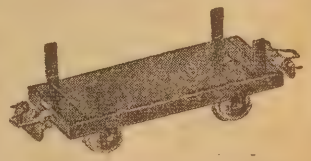
THE 100% AUSTRALIAN MODEL RAILWAY EQUIPMENT

MODEL F48: SUBURBAN ELECTRIC POWER CAR

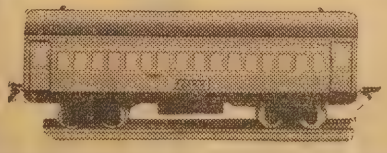
An accurate model of Australian electric suburban trains. Incorporates automatic stop, start and reverse and illuminated headlights. Power wheels are also rubber-tyred. £7/11/-
Also available with hand-operated reversing switch. . . . £6/12/3



BOGIE TYPE, 4 SIDED WAGGON, £1/5/6



4 WHEEL TIMBER TRUCK, 13/6



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LUGGAGE VANS £1/17/3
ELECTRIC PARCEL VANS (Power Cars) . . £7/19/9
SUBURBAN TRAILER CARS £1/11/3

TRACK LAYOUT (Size: 7' 6" x 5' 6")

Consisting of 16 curved and 9 straight rails, 1 pair manually operated points £4 17 0
When fitted with electrically operated points £9 11 0

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Please send me by return post illustrated details of Ferris model railway equipment.

Name .....

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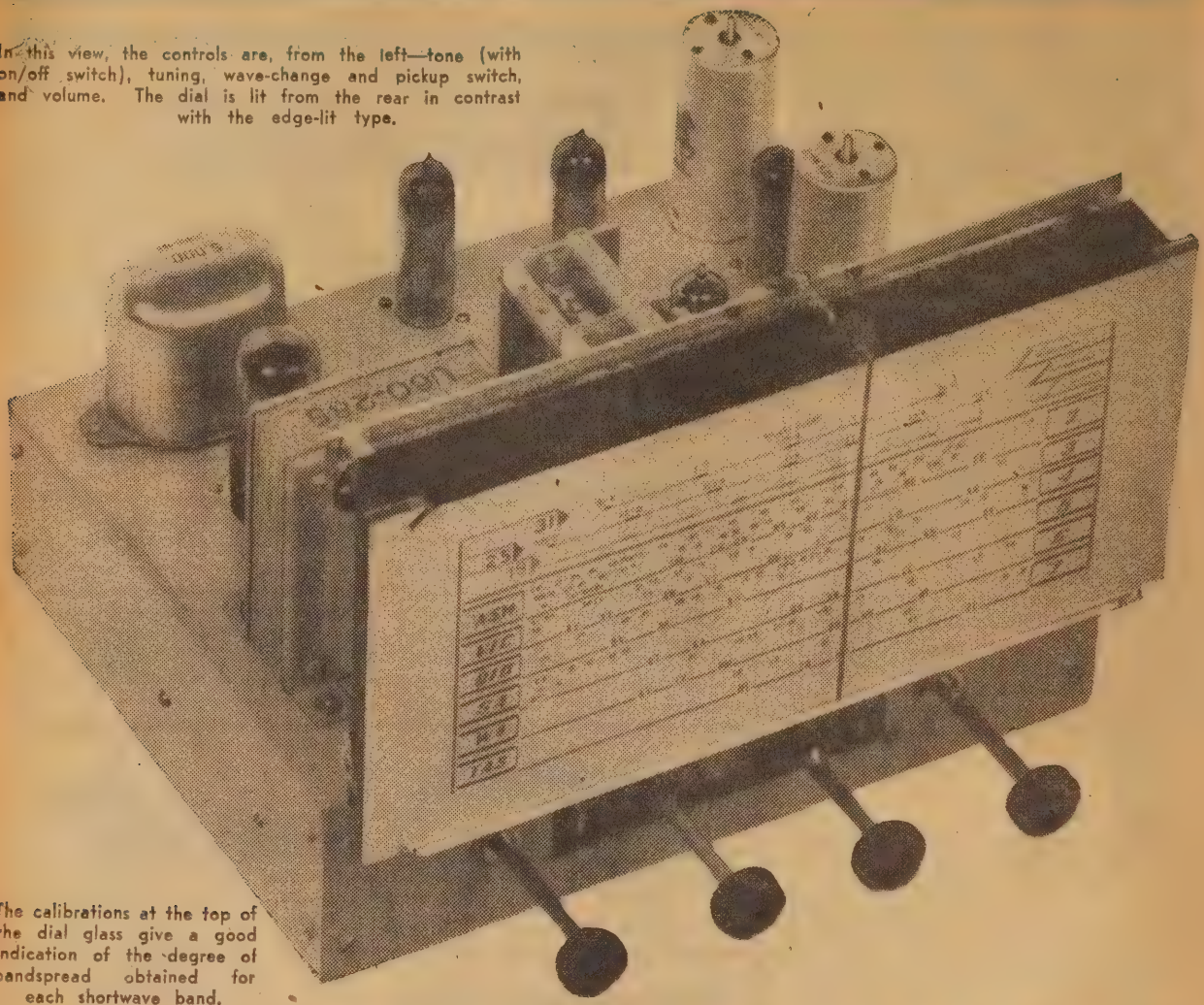


In this view, the controls are, from the left—tone (with on/off switch), tuning, wave-change and pickup switch, and volume. The dial is lit from the rear in contrast with the edge-lit type.

The calibrations at the top of the dial glass give a good indication of the degree of bandspread obtained for each shortwave band.

A NEW FOUR BAND RECEIVER

Here is a new set designed to meet the needs of many readers who specially like to listen to oversees programs on the international short-wave bands. It will also tune the broadcast band and has provision for pickup connection. It is built around a recently-marketed band-spreading coil unit, which allows short-wave stations to be tuned with the same ease as those on the broadcast band. It employs five valves, including the rectifier.

by Raymond Howe

WE have had frequent letters from readers, particularly new Australians who have settled in this country during the past few years, concerning the design of a set to tune shortwave programs from their native coutnry.

Our experience in this regard has obviously not been unique because various coil and set designers have recently been turning their attentions to the same problem. The coil kit, which we have used in this set, is one example of their work—and a very good example it is, too.

Shortwave listening by the general public is not, of course, anything new. It "arrived" in the middle 30's, and, for many years, no set was complete without a short-wave band. Whether the facility was ever used was beside the point!

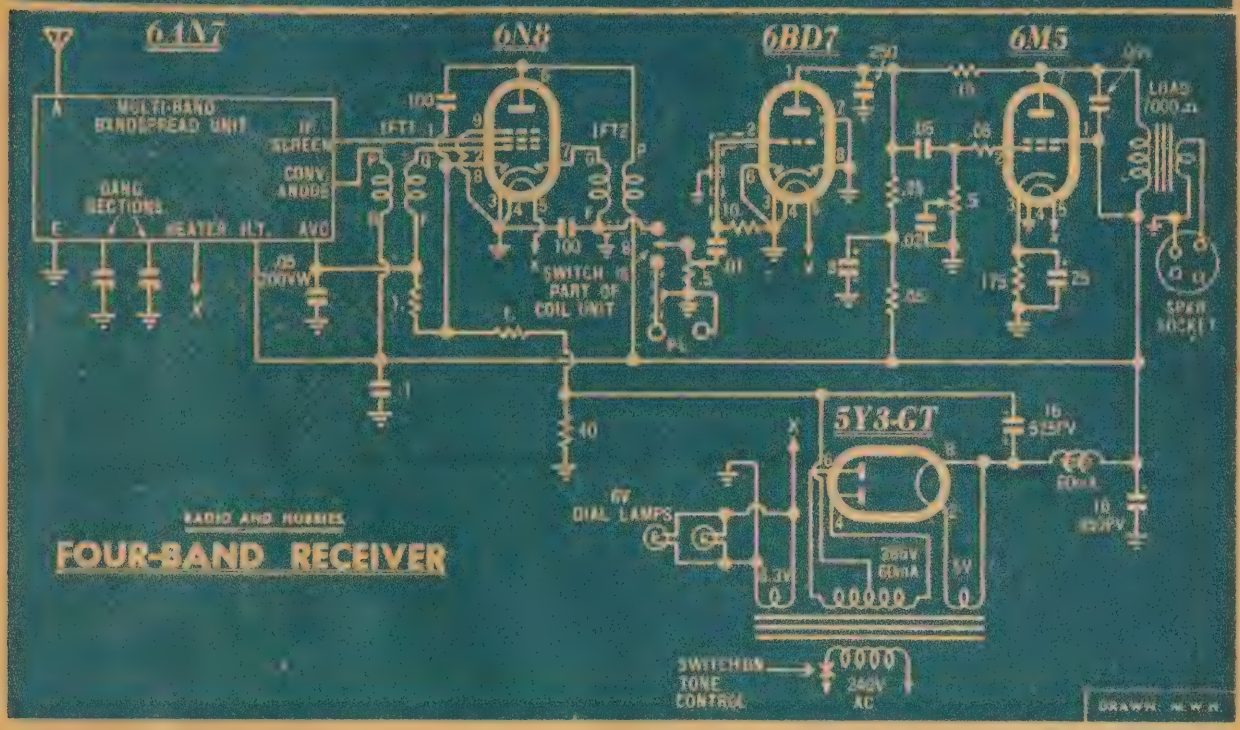
Nearly all the sets sold at the time—and since—have been of the "dual-wave" or "triple-wave" variety, covering a very large portion of the shortwave spectrum in one sweep of the dial.

Unfortunately, this wide coverage is a mixed blessing; because international broadcast stations have been so mixed up with morse code, so closely packed in narrow bands and so sharp in their tuning that only the more painstaking listeners ever managed to sort them out and listen to them on a systematic basis.

General coverage is fine, if you want to listen to morse signals, amateurs, Press services, shipping and so on. If you don't, then it's merely confusing.

For this reason there is at present

NEW FOUR-BAND RECEIVER CIRCUIT DIAGRAM



Excluding the coil unit, the circuit design is, in principle, similar to the standard 5-valve versions. Note that the particular coil unit used carried the pick-up switching on the wave-change switch. The amount of treble cut on the tone control should be sufficient for de-emphasis of microgroove recordings.

a marked trend toward the idea of covering only those bands on which international shortwave stations are heard to good advantage. These bands are spread out across the dial face and the "territory" in between them completely ignored.

Tuning becomes much less critical, stations occupy a distinctive position on the dial and can, therefore, be sorted out without much difficulty. It is, in fact, just about ideal for the folks who have a special interest in news and music from overseas.

This new set then is built around a multi-band coil, which carries three shortwave positions on the switch, together with the broadcast band and a position for pickup. In this last position the tuning end of the set is rendered inoperative to avoid possibility of "play-through" of radio programs when listening to recordings.

The shortwave bands covered are the 31-metre, 25-metre, and 19-metre, the respective tuning coverage being 9.4 Mc to 9.8 Mc, 11.5 Mc to 12.1 Mc and 14.7 Mc to 15.6 Mc. As you can see, these bands which would cover less than an inch on a conventional dual-wave dial, are electrically spread to cover the whole dial with this new coil unit.

MULTIPLE-TRANSMISSIONS

Actually, a few international shortwave stations do fall in between the selected bands as well as other stations, such as radio-telephone services, air and ship communication, radio amateurs, and so on, to which quite a number of listeners enjoy tuning.

However, if the main interest is in the international shortwave broadcasts, most of it centres in the selected bands. As a matter of fact, some programs are transmitted simultaneously on several bands to ensure good reception in various parts of the world.

To extract the best from shortwave listening, it is of great advantage to become familiar with certain elementary factors which affect reception conditions. Such points as the time of day, the season of the year will govern the strength of a program between two parts of the world for a given frequency band.

Current details on the stations being heard at good strength in Australia, their frequency of operation and times of operating are of good assistance. The shortwave notes, published in each issue of this magazine, are a handy source of information.

The position of stations on a dial is given in these notes in terms of frequency in kilocycles (Kc), while the markings on the dial glass are in megacycles (Mc). A frequency in Kc can be converted to read in Mc simply by moving the decimal point three places to the left. For instance, a frequency of 9665 Kc is equivalent to 9.665 Mc.

This brings up the question of accuracy of alignment with respect to dial markings. In a dual-wave set, with its wide coverage, it is quite likely that the calibration could

PARTS LIST

1 chassis 12in x 9½in x 3in.
1 power transformer 285V a side at 60mA, 6.3V at 2A, 5V at 2A.
1 .60 mA filter choke.
1 2-gang tuning capacitor.
1 multi-band bandspread coil unit.
1 dial with glass to suit gang and coil unit tuning ranges. (USL 51.)
2 455 Kc IF transformers, Nos. 1 and 2 preferably high gain.
1 7000 ohm speaker transformer.
3 9-pin miniature valve sockets, 1 octal and 1 4-pin miniature speaker socket and plug.

VALVES

1 6AN7, 1 6N8, 1 6BD7, 1 6M5, 1 5Y3GT.

CAPACITORS

1 25 mfd 40PV, 1 16 mfd 525PV, 1 16mfd 350PV and 1 8 mfd 350PV electrolytics, 1 .1 mfd, 1 .05 mfd, 1 .05 mfd 200VW. 1 .02 mfd, 1, .01 mfd, 1 .005 mfd, 1, 250 mfd, 1 250 pf, 2 100 pf.

RESISTORS

1 10 meg. ½w, 3 1 meg. ½w, 1 .75 meg. ½w, 2 .5 meg. potentiometers (long shaft), 1 .25 meg. 1w, 2 .05 meg. ½w, 1 175 ohm ½w, 1 40 ohm ½w.

SUNDRIES

4 terminals (2 red, 2 black), 4 knobs (to suit cabinet style and toning), 1 5tag, 2 4-tag and 1 2-tag mounting strips, 1 ¼ extension shaft, power flex and 3-pin flat plug, 2 6V dial lamps, approx. 4ft shielded hook-up wire, rubber grommets, spaghetti sleeving, hook-up wire, solder, solder lugs, nuts, bolts.

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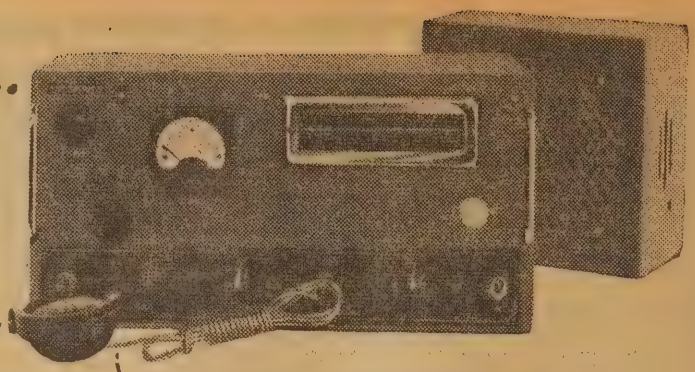

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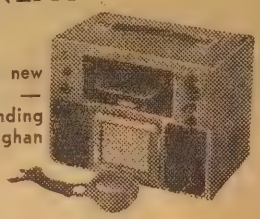

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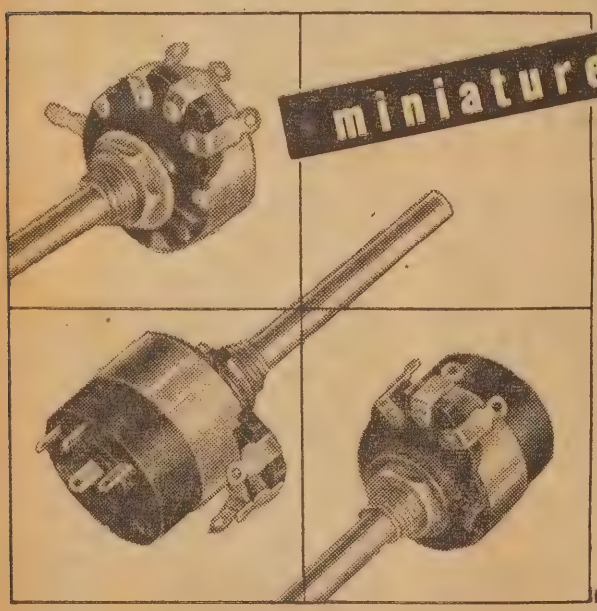

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be in error by up to 100 Kc or more.

In the case of a bandspread unit, such as the one used in this set, the dial tracking problems are not nearly so great, and, generally, the error may well be less than 20 Kc. Thus, a station is easier to locate on the dial as well as being easier to tune physically.

A modern set is capable of giving reasonable shortwave reception with a short length of aerial run around the picture rail in a room. However, where circumstances permit, it is advisable to use an outside aerial to give the set a better chance.

While a simple inverted L-type of aerial is generally satisfactory, a more pretentious aerial can be erected with very little extra effort. As an example, we refer to the double-doublet, as described in the November, 1948, issue. It has an added advantage of reducing man-made interference.

In designing this set, we considered that its main role was to provide broadcast and shortwave entertainment. Consequently, the circuit follows along conventional lines without any fancy additions. Such items as a tuning indicator could be added if an individual desires it. The method of connection has been discussed in some previous designs and we would refer you to, say the Bandspread Six set or the complete article on "magic eye" tuning indicators in the May, 1952, issue.

The bandspread coil unit carries the socket for the 6AN7 converter already wired. It also carries the AVC decoupling components for this stage, the oscillator anode dropping resistor and the screen resistor and bypass for the converter and IF valves.

SCREEN VOLTAGE

For about 240 volts of HT and two volts of back-bias to the 6AN7 and a 6N8 in the IF stage, we found that the screen voltage at "no signal" conditions was a little on the high side, while the dropping resistor dissipation was approaching the rating of the resistor. Some might query the coil unit design on this point.

A suggested method of modification here is to replace the .022 megohm resistor in the unit with two I watt resistors of .05 megohms connected in parallel and to connect a 1 watt resistor of .075 megohm from the common screen connection to chassis.

The contacts at the rear of the third switch wafer from the front open-circuits the screen feed to these valves, when in the "pickup" position. Other contacts at the front of this wafer switch the grid of the first audio either to the detector or to the pickup terminals.

DETECTION AND AVC

The first audio valve is the 6BD7, a duo-diode-triode. The diode anodes are not required and are earthed. These diodes could have been used for detection and AVC, but the use of those in the 6N8 envelope confines the RF and IF circuitry to two stages, simply as a matter of wiring convenience.

This stage drives the 6M5 output stage. About 12 db of gain reduction with negative feedback was introduced by the .75 megohm resistor connected between the anodes of these stages. This gives an input sensitivity at the pickup terminals of just over .2 of a volt, which is adequate for crystal pickups, as normally employed on record players and record changers.

We used a 5Y3GT rectifier in the power supply rather than the miniature 6.3 volt type to avoid overloading the single 6.3 volt heater winding, which is already running at rated load when two six-volt dial lamps are wired in. It is a debatable point, however, because to save an overload of about 4 watts on one winding, we use another rectifier which loads the 5-volt winding to 10 watts.

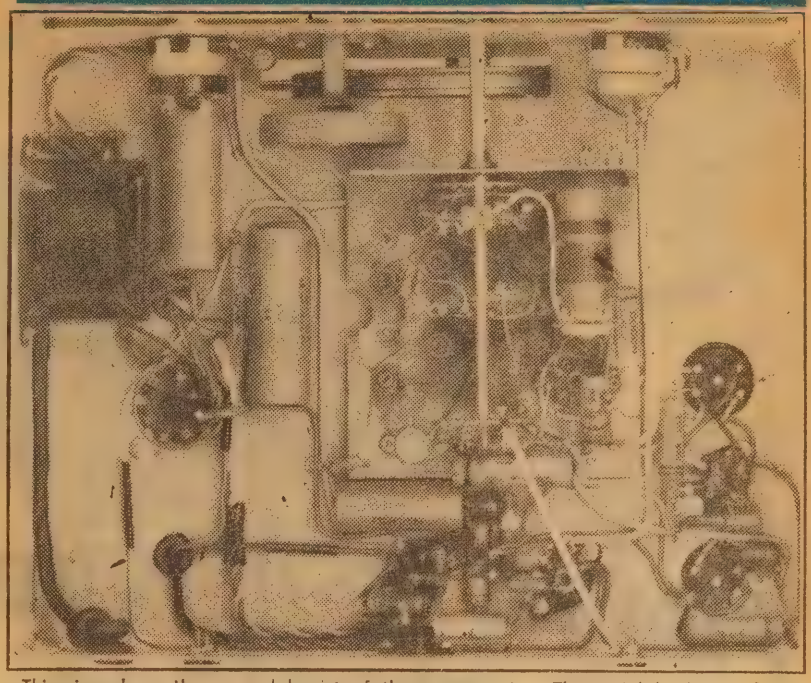
Layout requirements of the set demanded a new chassis design, which measures 12in by 9¼in by 3in. The various photographs show the location of the major components and the relationship of the coil unit to the other wiring.

The dial glass supplied by the coil unit manufacturer will fit only one of the available standard dials. It is the Efco USL51. Its type of construction demands longer shafts than usual for the controls, although the actual length in use will depend upon the thickness of the cabinet front.

RESISTOR CHART

VALUE	BODY	END	DOT
10 meg.	brown	black	blue
1 meg.	brown	black	green
.75 meg.	violet	green	yellow
.25 meg.	red	green	yellow
.05 meg.	green	black	orange
40 ohms	yellow	black	black

UNDERNEATH VIEW OF THE SET



This view shows the general layout of the components. The aerial lead runs from the front of the coil unit through the power supply wiring to its terminal at the rear. See that the braid of the shielded wiring does not short any part of the wiring. If necessary, slip insulated sleeving over it.

It would thus be wise to buy the long-shafted potentiometers. You will also need an extension shaft for the coil unit switch, or, alternatively, a length of ¼in diameter shaft coupled through a "¼in to ¼in" coupling.

The tone control potentiometer carries a switch, wired in series with the connection to the power transformer primary winding, so that the set can be switched on and off from the front of the cabinet. This switch requires a single-pole-single-throw action only. The one seen in the underchassis view happens to be a double-pole-double-throw type of which one section only need be used.

In mounting the major components, there is a certain sequence necessary with the gang and coil unit. The rear mounting bracket of the gang tuning capacitor should be secured to the chassis and, if you use bolts longer than ¼in, they should be cut off close to the nut to avoid fouling the coil unit bracket.

The coil unit is now slipped into position, taking care to feed the two green leads, which connect to the gang sections, through the appropriate holes in the chassis. You will need 5-32in diameter bolts with whitworth thread as on the standard 1-8in bolts.

The front mounting bracket is then fitted to the gang capacitor and with the gang temporarily in position, the leads to the gang from the coil unit are cut to length, bared and tinned with solder.

GANG MOUNTING

The front bracket of the gang is bolted to the chassis and the gang secured to its rear bracket already mounted on the chassis. In tightening the bracket studs into the gang

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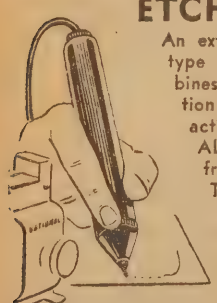

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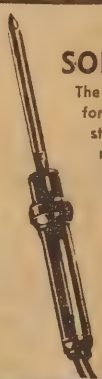

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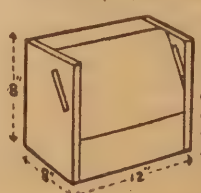

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frame, see that no stress is thrown upon the gang frame.

We would normally suggest at this stage that the dial be mounted because it helps the chassis stand on one end but, due to the particular method of securing the dial glass in position, we feel that it would be wise to defer its attachment until the chassis has been through the necessary gyrations in the mounting of the other major components.

The transformer should now be mounted, as it can take the place of the dial to stabilise the chassis. Then follows the valve sockets, IF transformers, output transformer and down to the rear terminals and speaker socket.

As you can see from the rear photograph, the output transformer behind the rectifier is of the standard type which fits on to a speaker. We deliberately allowed sufficient room here for a better quality output transformer, if required.

It is a good plan to mount the valve sockets and the IF transformers with the following orientation to give a logical lay-out for the wiring and minor components.

The lay of a socket is identified by the position of the gap between pins 1 and 9. For the 6N8, this is toward the 6BD7 position, for the 6BD7, it is toward the speaker socket and for the 6M5, it is toward the 6N8.

IFT ORIENTATION

With the No. 1 intermediate frequency transformer (IFT1), the "G" pin should be the one closest to the 6N8 socket and with IFT2, the "G" pin should be toward the 6BD7 socket.

The lay of the rectifier is not very important but, as a matter of interest, we have positioned it so that the valve spigot keyway is toward the speaker socket.

If, at this stage, the cabinet for the set is available, the dial could be mounted temporarily and set fitted to the cabinet to ascertain the required length of shaft for the controls. These can then be cut to the particular length before being fitted to the chassis.

Of course, you can still cut the shaft to length after the set is finished but to avoid too much stress on the dial plate and controls, it is advisable to have someone hold the set steady while the excess shaft length of each control is held in a vise for cutting. Please yourself on this point.

FITTING DIAL

You will notice, that to fit the dial to the chassis, the drive shaft will need shifting to the left-hand hole. Take care in this transfer, if you want to keep the drive cord on the drum.

Once the required length of the dial shaft has been noted, remove the dial and cut off the excess in a vise. At this stage, you could fit the correct dial glass to suit the coil unit. Some care will be needed here to avoid the heart-breaking blow of cracking the glass.

Carefully bend back the metal tongues at the corners of the dial frame to release the dial glass. Undo the nut from the bolt holding the dial drive drum to the dial plate but leave the bolt in position. Bend the tongues back to their retaining position, lay the new dial glass in place and insert the rubber packing strips at each end. If they slip in too easily, remove the glass, bend the tongues down a little and repeat the process.

Another method is to lay the glass in place on its rubber strips and, while squeezing the glass and edge of the dial frame between the finger and thumb, bend each tongue back into position. If, on releasing the glass, the rubber strip does not force it gently against the tongue, squeeze it again and bend the tongue down a little. Take care here with the pliers, as a slip of the grip may spell disaster for the glass.

We are not sure at present of the final marketing arrangements for the dial and glass. It may be that the coil unit manufacturer will be able to supply the glass already fitted to a dial.

SOLDER LUGS

Back to the job of wiring. Obviously, we will want to make connections to the chassis at various points and to do this we fit solder lugs under the nuts of certain bolts. For this reason, we recommend that the paint should be scraped away from around the topside of the valve socket mounting holes and the underside of the IFT mounting holes. This could also be done for the coil unit but it has an earthing braid to ensure contact with the chassis. Incidentally, this is soldered to a bolted solder lug just near the left-hand rear edge of the coil unit plate.

We mounted solder lugs on the securing bolts for each 9-pin socket and under the securing nut of IFT2 near the chassis side.

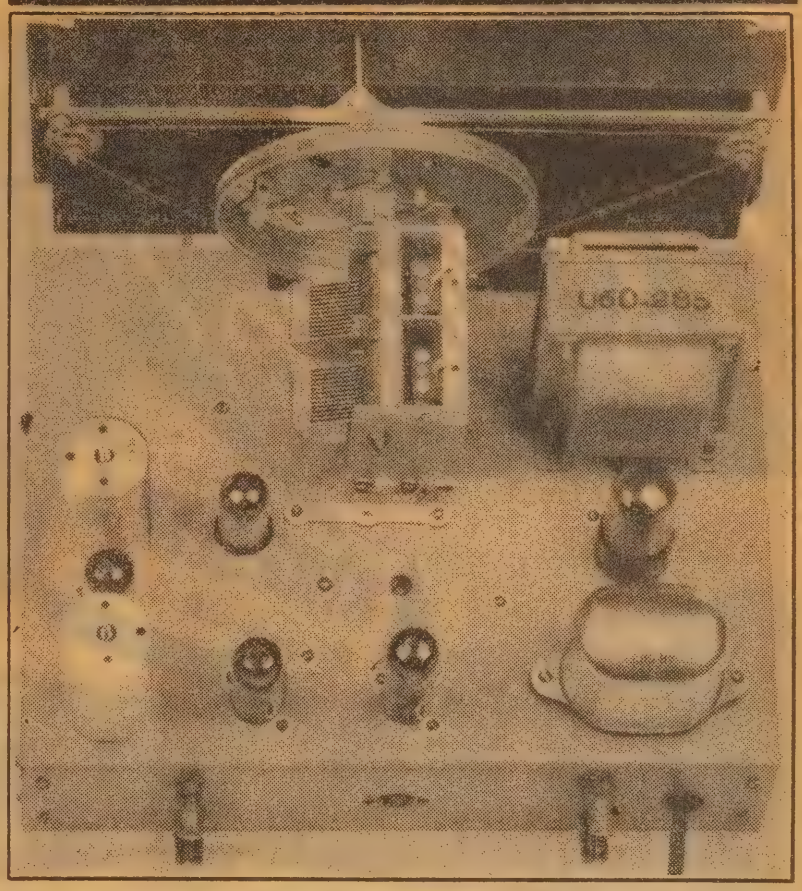
Tag mounting strips are used at a number of positions to carry minor components and wiring junctions. A 2-tag strip is held under one of the 6N8 socket bolts. This holds one end of the 1 megohm AVC diode load resistor, which returns to the junction of the power transformer HT centre-tap and the 40 ohm back-bias resistor.

A 4-tag strip is mounted in a hole provided between the 6BD7 and 6M5 sockets to carry the .25 megohm and .05 megohm resistors, the anode connection of the 6BD7 and one end of the 250 pf, the .05 mfd and the 8mfd electrolytic, plus a connection to high tension.

A 4-tag strip is mounted under a power transformer mounting bolt near the chassis corner to carry the connections of the power mains flex, the transformer primary winding and the leads to the switch at the back of the tone control potentiometer.

The 5-tag strip is held under a power transformer mounting bolt near the rectifier socket. This carries the 40 ohm back-bias resistor and its junction with the transformer centre-tap and the first 16 mfd electrolytic filter capacitor, and the high

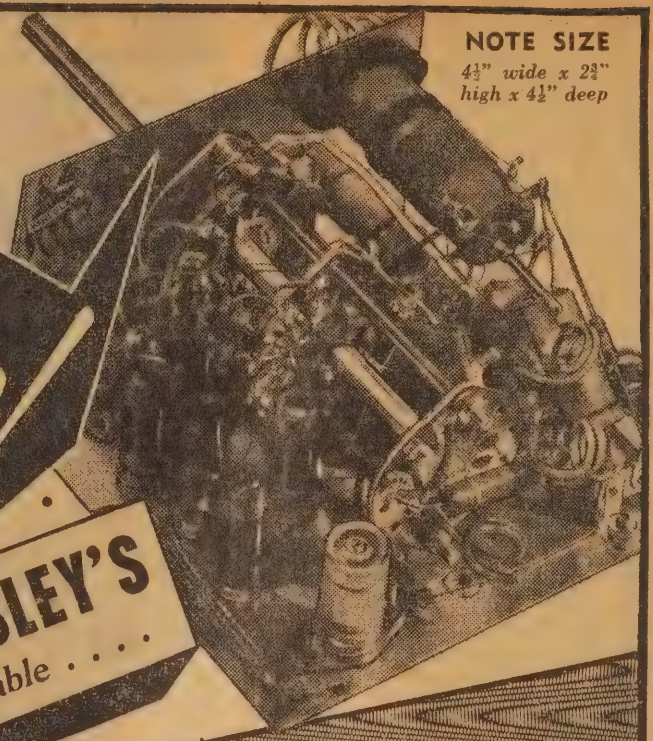
REAR VIEW OF THE RECEIVER



From the top left are the IFT1, 6N8, IFT2 with the 6BD7 and 6M5 along the rear edge. The 6AN7 is between the IFT1 and the gang capacitor. The power supply and the output transformer occupy the right hand side of the chassis.

NOTE SIZE
4½" wide x 2¾" high x 4½" deep

It's here!



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tension point at the junction of the second 16 mfd electrolytic and the filter choke.

A 2-tag strip is held on the front face of the coil unit plate under a second nut placed on the bolt holding the broadcast band aerial coil. This strip carries the junction of the .01 mfd coupling capacitator at the volume control and its shielded run across the 6BD7 socket.

The centre spigot of all of the miniature valve sockets acts as a shield between critical pins and should be earthed directly to avoid instability. Other socket pins which require earthing can be bent over and soldered to the spigot.

In the case of the heater circuit, we were prompted by the wiring of the 6AN7 socket in the coil unit to depart from our usual trend. Here one side of the heater is earthed and the other side brought out as a single lead. Accordingly, we earthed one heater pin at each of the other 9-pin sockets and connected together the other heater pin of each socket. Pin 4 happens to be the heater pin earthed at these three sockets as it is close to the solder lug held under the adjacent mounting bolt at each socket.

PRELIMINARY WIRING

Before fitting the minor components into position, it is best to lay in the straight wiring runs between valve sockets, IF transformers and coil unit. This avoids threading them under and around components and keeps them tucked close to the chassis. Keep the anode and grid leads of the 6N8 as short as possible.

Incidentally, the lead which protrudes from the can of the IFT1 actually connects internally to the "G" pin. It is provided for use where the grid connection of the following valve is at the top of the envelope. It is not required in this case and should be clipped off close to the can, or the transformer removed from the can and the lead clipped off near the pin.

IMPORTANT POINT

An important point to watch in the wiring of the 6N8 socket is the length of the connections to pin 8. The pigtails of the 100 pf capacitor and the two 1 megohm resistor should be no longer than necessary to make suitable connection and the body of either resistor kept away from pin 2, the grid pin of the 6N8. This is to avoid unwanted coupling between the input and output of the stage which would lead to instability.

The 10 megohm resistor should be wired at the socket of the 6BD7 and not at the other end of the shielded lead as might be inferred in the circuit diagram, where convenience of drawing is more important than actual location of components.

In the case of the 6M5, pin 9 is a blank pin and is used to carry the junction of the .05 megohm resistor, the .05 mfd coupling capacitor and the shielded lead to the tone control.

Note that shielded lead is used for connection to and from the volume control, from the pickup switch to IFT2 and pickup terminals and between the 6M5 and the tone control.

In the wiring to the controls, it is wise to earth the shield braid somewhere near the respective valve sockets rather than at the front of the chassis. This is a precaution against hum induction from eddy currents in the chassis.

So much then for the actual construction of the set. Before it can be placed into service, however, certain circuits require what is termed "alignment". These are the IF transformers and the coils in the coil unit.

Ideally, the first step is to align the IF transformers to 455 Kc. If you are unable to borrow a service oscillator or any simple device which will produce a modulated signal on 455 Kc, the IF transformer adjustments are best left alone until the broadcast band aerial and oscillator coils are adjusted.

Connect an aerial to the set, place the wave-change switch in the "broadcast" position and, if the set has been correctly wired, you should be able to receive some stations.

Lock the dial drive drum onto the gang shaft so that with the gang full in mesh, the pointer falls just beyond the right hand edge of the scale.

Select a station toward the low

(Continued on Page 119)

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FROM THE SERVICEMAN WHO TELLS

Both of my main stories this month deal with troubles encountered by hobbyists who attempted to service their own sets, but soon found themselves out of their depth. I also have a possible solution to a previous mystery and yet another "butchered" speaker story.

TO my fellow servicemen, particularly if they should be new to the game, I would commence with a little advice. Don't ever be deceived by the customers' statement that the set " . . only needs to be aligned". Believe me, such an apparently innocent remark can hide a whole heap of trouble.

One usually encounters this problem when dealing with those enthusiasts who like to "roll their own", but who lack the facilities to align the completed receiver. As a result they turn to the nearest serviceman, yours truly in this case, to do the job for them.

STRIFE

Of course, they are quite prepared to pay for the service and one would be less than human if he were not sympathetic to their problems. Wherever possible I try to fit such jobs in during slack periods or on a spare time basis where they won't prove quite as costly as a regular service job, an arrangement which is mutually satisfactory in most cases.

But things can get out of hand. Experienced builders can usually turn out a good job which does in fact, " . . . only need lining up to finish it off". The less experienced ones, alas, can run into more strife than Speed Gordon.

Lacking the necessary experience their wiring and layout is often completely haywire, and, at the best, they will have been lucky to make all the connections correctly. If their luck holds the set will work as soon as it is switched on. "Ah," says the enthusiast. "It only needs to be lined up now and it will be a real beaut. I'll take it round to the serviceman and get him to do it for me."

WIRING & STABILITY

What our friend cannot appreciate is that the hopeless mess of wiring and poor layout is a perfect set-up for instability, and that, as soon as the gain comes up with correct alignment, the whole thing will burst into violent oscillation, thus creating the seeming paradox that a correctly aligned set will perform worse than an incorrectly adjusted one.

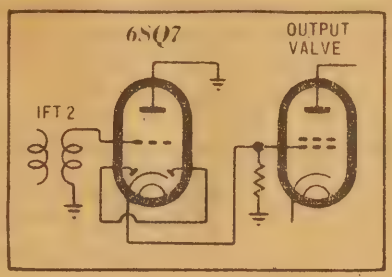
In such cases one may be tempted to attack the trouble in the hope of curing it without too much waste of time, but it is a risky business. One can easily spend several hours tidying up such sets and run up a labor charge which will embarrass the customer if you present it, and yourself if you don't.

After a few such experiences I try to avoid becoming too involved in such problems. I align them on the understanding that I will finish the job if they don't oscillate. If they do—well, that's too bad, and the customer takes that risk.

Of course, a few words of advice may often solve his problem, and I am happy to do what I can in that regard, but I leave the actual modifications to him. If he cures the trouble I can usually manage to complete the job at a later date without further charge.

However, it is best to treat each case on its merits, and not to promise too much.

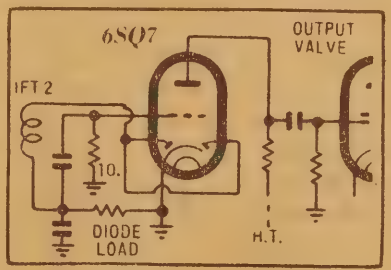
Naturally, all the foregoing was prompted by a case, though it really comes into a somewhat different category; that of the amateur repairman who gets his set into a mess and still believes, or at any rate maintains, that it only needs



This is how our hopeful friend had wired up his 6SQ7, which for obvious reasons didn't work.

alignment to fix it. In this regard I am quite sure that many, including the one I am about to mention, honestly believe that the set only needs alignment if it makes any kind of noise at all, even if it is only a hum or crackle.

The set in question was a fairly old one, as evidenced by the fact that it used, among a rather motley collection of four and six volt types, an E444N diode tetrode. It was this valve which had caused the bother, for it had failed and the owner was unable to obtain a replacement. Someone had advised him that a 6SQ7 could be used in its place,



A change to a more recognisable circuit cured his troubles.

with some modifications, and he had set out to tackle the job himself.

But when the changeover was completed the set refused to work, though I suspect that, in probing around the audio wiring, the owner produced some noises in the speaker which he took as indicating that the set would work if only it were correctly aligned. (I know it sounds silly, but it's the only explanation I can offer.)

So he attacked the trimmers, padder, and IF trimmers, and twisted them merrily in and out in a vain attempt to find some signals. When he couldn't find any signals, he bundled the set up and brought it to me, still maintaining that all it needed was alignment.

WRONG CONNECTIONS

It didn't take me long to realise that the set was completely dead and a quick check over the altered wiring revealed half a dozen reasons why. Our friend had managed to replace the socket correctly, pick up a six-volt filament supply and wire this to the correct socket pins. He had also disconnected the screen dropping resistor and by-pass, which was correct as the 6SQ7 is a triode.

But from there on he had gone hopelessly astray. The two diode pins were connected together, which was correct since there was no AVC system, but they were connected to nothing else. The secondary of the second IF was connected between the grid and chassis, the plate of the triode section was earthed, while the cathode was connected to the grid of the output stage.

This last arrangement had all the earmarks of having been designed by a worshipper of direct coupling and cathode followers, who had become mentally unbalanced by his never-ending search for high fidelity.

The only good thing about the whole arrangement was that it was so obviously wrong that it would be relatively easy to correct, so I set to to make it into something rather more conventional and, more important, something which would work.

CORRECTIONS

First the plate was "unearthed" and connected to the HT via a correct value load resistor and to the output grid via a coupling condenser. The cathode was earthed and the grid circuit completed with a 10 meg. resistor. This would provide the necessary bias for the valve and is quite a conventional arrangement.

The second IF was disconnected from the plate and wired to the diode and diode load resistor. This last was present but had not been used in the haywire set-up. Finally a coupling condenser from the diode load to the 6SQ7 grid completed the modifications.

Now when the set was switched on it showed some signs of life, though it was extremely weak and only received a few stations along with a lot of heterodynes. In fact, it really

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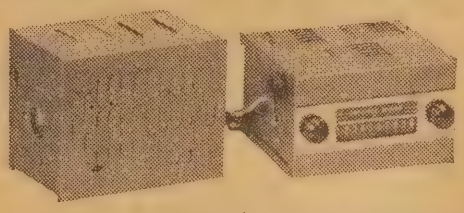

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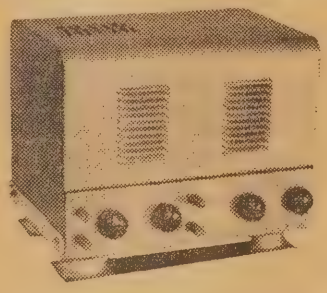

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did sound as though it needed to be aligned. In view of what I subsequently found, this assumption was something of an understatement.

Feeding the generator into the IF channel I was unable to obtain any response at all even though I swept across the dial from about 600 Kc down to 300 Kc. Switching to the next band I took the generator further toward the high frequency end—eventually striking oil at nearly 800 Kc!

Although this seemed a long way from home further tests confirmed that it was actually on this frequency, while an examination of the trimmer screws showed them to be screwed well out—almost falling out in fact.

The degree of error was finally confirmed by the simple procedure of resetting each trimmer a little at a time and following the response down the band with the generator. After about six such rough adjustments, and at a point where the screws were beginning to exhibit some tension, I was able to set the channel on 465 Kc, a frequency which I happened to know was correct for this particular model.

LINING UP

As I more or less expected, the trimmers and padder were similarly off the beam and some time had to be spent bringing them back into line. When this was done the set put up quite creditable performance, a fact which softened somewhat the financial blow, which was rather harder than it would have been for a simple alignment job. In fact, the owner was quite happy with the whole transaction and fully appreciated the errors which had been made and the work which was involved in correcting them.

At the same time he still seemed only partly convinced that the set could not have produced signals of any kind in the condition it was when I received it.

Strangely enough I had another case of amateur repairs this month, and this also involved alignment trouble, though to a lesser degree. In this case there was also rather more excuse for the owner getting into trouble.

The set was a very old one, being one of the old autodyne variety employing 57's, 58, 2A5, and 80. It seemed that the owner had acquired it for virtually nothing and was trying to patch it up as a second set. He dabbled in radio to some extent, had built one or two sets to modern designs, but was completely bushed in the old style set which was well before his time.

AUDIO SECTION

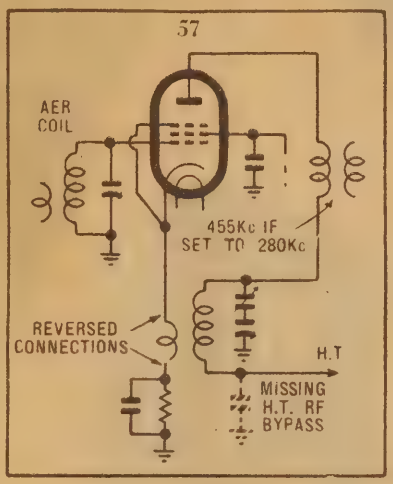
He had managed to establish that the audio section was working and that all voltages appeared normal, but was unable to get any kind of response from the front end.

I first heard about the problem when he came to me for advice, suggesting that the oscillator was not functioning and asking my advice as to the possible causes. He explained that he was keen to do the job himself, partly to save cost, but mainly to gain experience and for his own satisfaction. I agreed that this was a normal outlook and promised to give him what help I could.

I advised him to check the valve, pointing out that swapping over the two 57's was an old trick, which often worked if the "first detector" was a little weak as an oscillator. Alternatively, I offered to check the valves for him if he brought them along to the shop.

I also mentioned the old trick of baking the oscillator coil, as well as the more conventional possibilities of shorted oscillator trimmer or padder, low HT due to a sick rectifier, absence of screen voltage due to an open circuit voltage divider, and so forth.

Subsequently he brought the valves into the shop and I checked them for him, the result being normal emission in each case. "Well," said he, "that just about brings me to the end of my tether. I've tried all the



A reversed cathode core and a missing bypass condenser led to troubles with this old set.

tricks you mentioned without success and I thought it must be the valves. What do I try now?"

I replied that I was more or less at the end of my tether also, at least as far as servicing by proxy was concerned, and that it was now clearly a case of coming to closer grips with the problem. If he cared to bring the chassis up to the shop I could probably find the trouble.

He agreed that this seemed logical and departed, promising to drop the chassis into the shop in the course of a day or two.

WEIGHTY PROBLEM

When he eventually did I could appreciate at least one reason why he had hesitated to bring it before. Whatever else might have been lacking these old sets, there was no skimping of the chassis, power transformers, &c. In fact, the whole thing was built like a battleship—and weighed nearly as much, according to the owner.

Things being a little slack we tackled the job jointly on the spot. While I was working out the speaker plug connections and getting the bench speaker into operation, he ventured the suggestions that there was also something wrong with the IF channel. It seemed that he had been able to borrow an oscillator and had attempted to align and check the IF channel, correctly assuming that, if he could get this much working, it would narrow the possible area of the fault.

Unfortunately, he had been unable to get the channel anywhere near the 175 Kc, which he believed was the correct figure and had finally given up in disgust. At this point I asked him why he assumed that 175 Kc was the IF, whereupon he replied that it was stamped on one of the cans. At the same time he pointed to the top of the aerial coil can where one could make out, faintly but definitely, the figures "175".

I agreed that this might apply to the IF channel, but, at the same time, I thought it rather strange that the IF figure should be printed on the aerial can. Anyway, the easiest thing to do seemed to be to feed the generator into the channel and see what kind of response was obtained.

THE RIGHT IF

This I did, eventually locating the response at 280 Kc, the trimmers in each IF can being screwed hard down. This discovery tended to confirm what I had half suspected from the first; that the IF was nearer 455 than 175, and that the owner has been misled by the figure on the aerial can.

This was further confirmed by an examination of the padder which was made up from a fixed .0003 mfd mica and two adjustable trimmers in parallel. Since each of these would have been around the 60 pf mark the total value would be close to 420 pf, or the value of a conventional 455 Kc IF padder.

So I tackled the IF channel and slowly coaxed it down to 455 Kc, at which setting the screws were just nicely positioned with moderate tension. Well, at least this much of the set now appeared to be functioning correctly.

But the owner had been right about the oscillator. It was as dead as the proverbial dodo. The windings proved to be continuous so that the valve at least had the correct voltages applied (it would have been impossible to check it as an IF amplifier had it been otherwise) and I began to look for some more subtle cause.

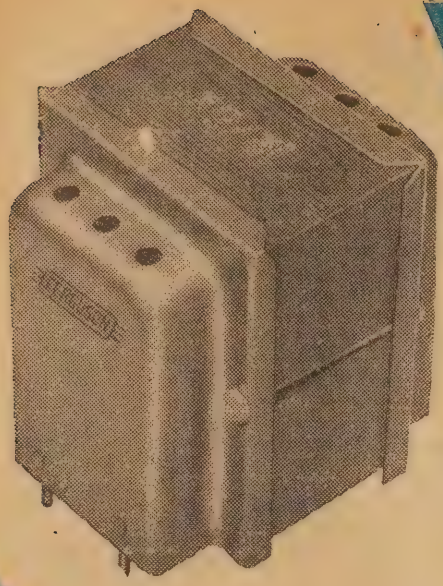
The soldered connections to the base of the coil had obviously been made comparatively recently, either by the present owner or someone before him. This suggested that they could easily have been replaced with one winding reversed, about the most effective method of preventing oscillation.

I slipped the can off the coil and inspected the windings. There is a simple method by which one can remember the connections to a solenoid autodyne oscillator coil, and I pass it on as a matter of general interest.

Assuming that two coils are both wound in the same direction, which is normal, the upper end of the top winding and the upper end of the bottom winding will be the "hot" connections, while the two lower ends will be the "earthy" connections. The "hot" connections in this case are, of course, the plate and cathode.

Assuming that one coil is wound over the other it is a simple matter

(Continued on Page 111)



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PF 300	240	325	40	6.3V/2A 5V/2A
PF 201	240	225	50	6.3V/2A
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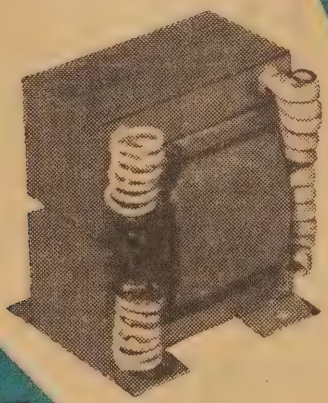

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PF300	240	325	40	6.3V/2A, 5V/2A
PF201	240	225	50	6.3V/2A

NOTE: All transformers are available with upright mounting. The following 9 transformers are also available with flat mtg., fitted with an adaptor plate to suit 3 x 3½in centres. On removal of plate, mtg. centres become 2½ x 3 1-8in. IF flat mtg. is required afix Code No by letter F e.g. PF151F.

PF151	230, 240	285	60	6.3V/2A, 5V/2A
PF166	230, 240	325	60	6.3V/2A, 5V/2A
PF165	230, 240	385	60	6.3V/2A, 5V/2A
PF170	230, 240	285	80	6.3V/2A, 6.3V/2A, 5V/2A
PF169	230, 240	325	80	6.3V/2A, 6.3V/2A, 5V/2A
PF168	230, 240	385	80	6.3V/2A, 6.3V/2A, 5V/2A
PF130	230, 240	285	100	6.3VCT/2A, 6.3V/2A, 5V/2A
PF164	230, 240	325	100	6.3VCT/2A, 6.3V/2A, 5V/2A
PF160	230, 240	385	100	6.3VCT/2.5A, 6.3V/2A, 5V/2A
PF152	230, 240	285	125	6.3VCT/3A, 6.3V/2A, 5V/2A
PF163	230, 240	325	125	6.3VCT/2.5A, 6.3V/2A, 5V/2A
PF181	230, 240	385	125	6.3VCT/3A, 6.3V/3A, 5V/2A
PF174	230, 240	285	150	6.3VCT/2A, 6.3V/2A, 5V/2A
PF142	230, 240	325	150	6.3VCT/2A, 6.3V/2A, 5V/3A
PF175	230, 240	385	150	6.3VCT/2A, 6.3V/2A, 5V/3A
PF167	230, 240	385	150	6.3VCT/2A, 5V/3A, 2.5VCT/5A
PF173	230, 240	425	175	6.3VCT/3A, 6.3V/2A, 5V/3A
PF140	230, 240	385	200	6.3VCT/3A, 6.3V/3A, 5V/3A
PF171	230, 240	385	250	6.3VCT/4A, 6.3V/3A, 5V/3A

POWER AMP. AND LOW POWER T/MITTER UNITS

PF172	230, 240	500	200	6.3V/4A, 6.3V/3A, 5V/3A
PF143	230, 240	600 500	200	2.5V/5A, 2.5V/5A, 5.5V/.5A
PF147	200, 230 240, 260	1000 750 500	200 250 300	5.5V/.3A
PF179	230, 240	475	225	6.3VCT/4A, 6.3V/2A, 5V/3A
PF107	230, 240	585	250	6.3V/3A, 6.3V/2.5A, 5V/3A

C.R.O. TRANSFORMERS

PF188	240	350 one ext. 900	30 2	6.3V/2A, 6.3V/1A 5V tap 4V/2A 4V tap 2.5V/2A
PF545	240	350 one ext. 1000	20 1	6.3V/3A, 6.3V/.6A, 4V tap 2.5/2A

TAPE-RECORDING TRANSFORMERS

PF642	230, 240	250	80	6.3V/3A, 5V/2A Low radiation
PF664	240	265	80	6.3V/3A, 5V/2A Low radiation

PHOTOFLASH TRANSFORMERS

HT119	200	4000 ½ wave	
HT131	240	1100 ½ wave	prim. also vib, 5.2 or 4V

POWER CHOKES

CODE NO.	HY. IND	DC RES.	DC MA.	CODE NO.	IND HY.	DC RES.	DC MA.
CF100	50	1900	10	CF112	10	70	250
CF101	30	870	25	CF113	5/20	70	50/250
CF102	15	300	60	CF115	.017	.6	2A
CF103	30	420	60	CF119	.005	.1	6A
CF104	30	580	80	CF162	10	90	330
CF105	15	250	80	CF196	20	130	125
CF106	12	200	100				
CF107	30	360	100	CF114*	40 watt fluor ballast		
CF108	12	.135	150	CF213*	20 watt fluor ballast		
CF109	20	225	150				
CF110	12	100	200				
CF111	16	165	200				

* Fitted with rubber mounting to reduce hum. Standard 5¼in hole centres.

VIBRATOR AND A.C. POWER TRANSFORMERS

CODE NO	PRIMARY VOLTS	HTV aside	HT mA	FILAMENTS
PF182	240AC 12V1B	200	40	12.6/1A
PF122	240AC 6V1B	220	40	6.3V/2A
PF125	240AC 6V1B	250	60	6.3V/2A
PF126	240AC 12V1B	250	60	12.6VCT/1A
PF119	240AC 6V1B	325	125	6.3V/4A
PF146	200, 230, 240 AC 12V1B	325	150	12.6VCT/2.5A

VIBRATOR TRANSFORMERS

CODE NO	PRIM VOLTS	DC Volts	O'put mA	Buffer Full Sec	
VT101	6	90	15	.008	
VT102	6	150	25	.005	
VT103	6	200	50	.005	
VT127	6	200	50	.005	Low radiation. Car Radios
VT104	6	250	60	.005	
VT107	6	250	60	.005	Low radiation. Car Radios
VT106	6	300	75	.008	
VT122	6	400	50	.005	
VT146	12 or 6	240AC	50w	1MFD	For Emergency light, etc.
VT112	12	200	50	.005	
VT132	12	200	60	.005	Low radiation. Car Radios
VT105	12	250	60	.005	
VT117	12	250	60	.005	Low radiation. Car Radios
VT114	12	300	75	.008	
VT123	12	320	125	.005	
VT113	24	200	50	.005	
VT116	24	250	60	.005	
VT115	24	300	75	.008	
VT119	32	150	25	.005	
VT100	32	200	40	.005	
VT124	32	250	60	.005	

FILAMENT TRANSFORMERS

CODE NO	PRIMARY VOLTS	SEC. VOLTS
PF118	220, 240, 260	2.5V/5A, 2.5V/5A
PF158	220, 240, 260	5V/8A
PF476	240	6.3V/3A
PF138	220, 240	6.3V/4A, 5V/4A, 2.5V/4A, 2.5V/4A
PF162	240	6.3V/3A, 6.3V/3A
PF154	200, 230, 240	7V tap 6V/7A, 6.3V/3A, 5VCT/5A 5V/3A, 2.5V/7A
PF102	240	7.5V/2A
PF111	240	10V/5A
PF211	200, 230, 240	10VCT/10A
PF131	230, 240	10VCT/10A, 5V/15A
PF123	240	15, 12, 8, 6V/1.8A
PF439	240	32V 60W Enclosed one outlet
PF457	240	32V 125W Enclosed two outlets
PF491	240	32V 200 W Enclosed two outlets

BATTERY-CHARGING TRANSFORMERS

CODE NO	PRIMARY VOLTS	SEC. VOLTS
PF265	230, 240	17V tap 11.5, 10, 8.5/4.2A
PF389	230, 240	17, 11.5, 10, 8.5V/4.2A, 17, 11.5V/4.2A 17, 11.5V/4.2A
PF537	240	17V tap 11.5V/0.4A

BELL TRANSFORMERS

CODE NO	PRIMARY VOLTS	SEC. VOLTS
PF648	240	10W Continuous or 2A intermittent.

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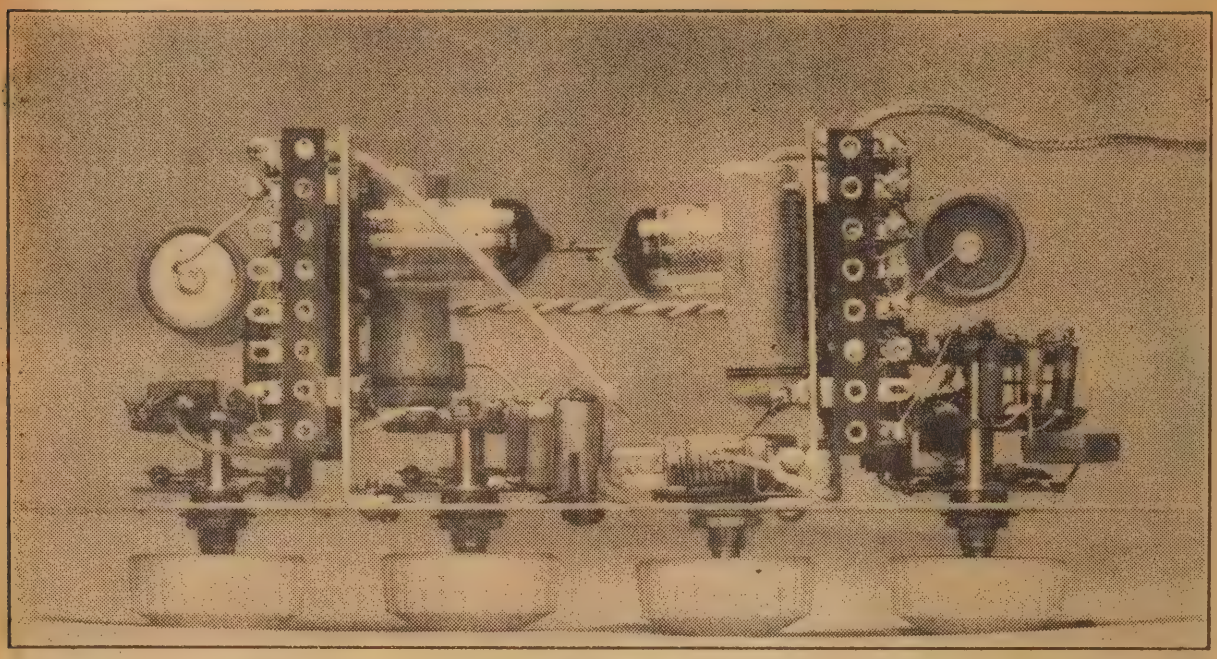


A side view of the unit removed from its cover. Note how the resistors and condensers are mounted across sections of the switch. Earth connections are made to the clicker plate by soldering. The dial light holder is mounted under one of the bolts fastening a bracket. Note the lead from the volume control to the second EF86 grid. The second 24 mfds electrolytic is connected across the high tension input lead, but may be included in the main amplifier. It gives extra protection against motorboating.

PLAYMASTER CONTROL UNIT SIX

Here is a control unit for use with any of the Playmaster amplifiers, or for general amplifier work, which combines high sensitivity with extremely low distortion, great flexibility, and stability. Although intended particularly for use with low output pick-ups, application of negative feedback allows it to be connected to almost any type without prejudice to performance. It has four pre-set response positions plus radio, and extra bass and treble controls.

by John Moyle

AT first thought, another Playmaster Control Unit may seem somewhat superfluous. Surely with five of them under our belts, there is no need for a sixth?

Actually the numbers attached to these amplifier units are there purely for purposes of identification. Each has its own place in the scheme of things, and if at any time it seems that a new one is indicated, either to improve on an existing design or to provide new requirements, then there is a job to be done.

The main reason Number Six was designed is that there are a number of pickups now being used — and their number is increasing—which have a very low voltage output, and therefore require more amplification than is provided by previous units.

FOR VARIABLE RELUCTANCE

An example is found in the latest Goldring variable reluctance pick-up which has recently been released and which has tested well. This pick-up has an output very much lower than the average magnetic, and requires an input sensitivity of about 10 millivolts to drive a Playmaster to full output.

It is questionable whether anyone would want to achieve a full 10 watts into a modern loudspeaker, or whether he could stand it if he did. For this reason the Control Unit Four works quite well with such a pick-up, but even with the gain flat out, it doesn't load up as much as many will require and, on lightly recorded discs, the gain is obviously not enough.

This is only to be expected from a unit with an input sensitivity of about 40 millivolts, but it's rather hard to increase it with a design using only one valve and with all the compensation features we require.

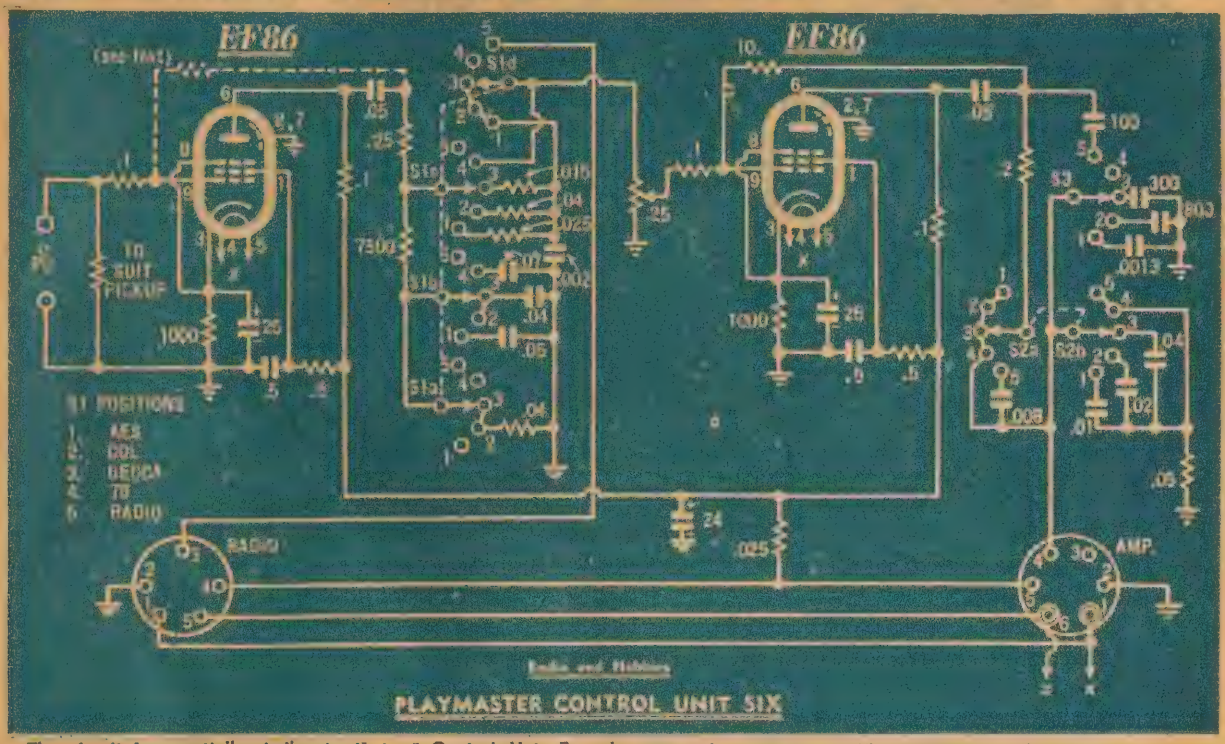
It became obvious, therefore, that to do much better than this, a new circuit was needed using two valves. The prospect opened up a number of interesting possibilities.

The first and most obvious was the use of a pentode valve in the initial compensation stage to get more gain than the triode would give.

HIGHER GAIN

The difference in actual figures would be rather hard to compute accurately because of the somewhat complex nature of the plate load, and the slight differences in actual plate volts applied to it, but using a suitable valve we should be able to obtain three or even four times as much lift from the pentode, taking the valve maker's estimates as a guide.

THE CIRCUIT FEATURES FEEDBACK TO ADJUST GAIN



The circuit is essentially similar to that of Control Unit Four but pentodes are used. The 10 meg feedback resistor shown connected to the second EF86 gives 6 db of feedback. A dotted connection shows where a feedback resistor is connected to the first valve, if required. The grid resistor to this valve will take its value from the recommendations for the pick-up you use, and may be anything from 1000 ohms to .1 meg. As shown, the circuit is suitable for variable reluctance pick-ups or others requiring a sensitivity of about 12 millivolts.

This would probably be enough extra gain, and we could leave the remainder of the circuit as it was in Number Four.

As this unit used a double triode, we would then have a spare triode unit. Our first inclination was to use this as a cathode follower output stage as we did in Number Three.

This would be quite a good idea, although we have experienced some valve noise, apparently due to heater cathode leakage, when using cathode followers of this type in comparatively low level circuits—probably a characteristic of individual valves rather than an inherent matter of design.

But you could adopt the scheme as a rebuild proposition for an existing unit.

But it also occurred to us that by using another pentode in this second stage, we could obtain opproximately the same amount of extra gain here as well, and offset it to our advantage by using the feedback from the plate circuit to the grid.

USE OF FEEDBACK

In fact, we could arrange to use some degree of feedback round each stage if we wished, thus reducing distortion—what there might be of it—and tailoring the over-all gain to just the amount we require.

If special low-noise valves such as the EF86 were used in both sockets, we should find a marked improvement in the microphonicity of the unit (what a word!) as without doubt a number of the double triodes are rather sensitive on this point.

So much so that a special job—the 12AY6—has been produced to cater for high gain triode stages. Unfortunately this valve has a medium-mu only, and is also about twice as costly—when it can be obtained—than the more conventional double triodes.

Considering the pentode valve as a direct replacement for the 12AX7 in the circuit, the point did arise as to whether the difference in output resistance of the pentode would upset the constants of the compensation networks.

The resistance in the network is made up of the two series resistors —.33 megs and 7500 ohms with a return to ground made up of the preceding plate resistor of .1 megs in parallel with the output impedance of the valve. We can neglect the coupling condenser which should have a negligible impedance at any frequency in which we are interested.

TRIODE IMPEDANCE

In the case of the triode, this, I resistor is effectively in parallel with about 50,000 ohms of valve output impedance, whereas for the pentode the plate resistance would probably be about a megohm.

A variation of this order in series with a circuit already having a resistance of over 330,000 ohms we did not think would make much difference, and so it worked out in practice.

Using an EF86 with the same plate load of .1 meg, a check on the response at 50 and 10,000 cycles, as

PARTS LIST

1 panel 10¼in x 3½in with brackets 3½in x 2⅝in.
1 case 9½in x 3in x 3½in deep.
1 switch 2-bank 2 x 5.
2 switches single bank 2 x 5.
1 .25 potentiometer.
2 EF86 valves.
Sockets: 2 Noval 1 6-pin, 1 5-pin.
Resistors ½ watt 5 pc: 1 .25 meg. 1 .2 meg, 2 .04 meg, 1 .05 meg, 1 .025 meg, 1 .015 meg, 1 7500 ohms.
Resistors ½ watt: 2 .5 meg, 2 .1 meg, 1 .025 meg, 1 .02 meg, 2 1000 ohms.
Condensers 200 volt 10 pc: 2 .04 mfd, 1 .02 mfd, 1 .01 mfd, 1 .0013 mfd, 1 .05 mfd, 1 .0003 mfd, 1 .07 mfd, 1 .008 mfd, 1 .0008 mfd, 1 .002 mfd, 1 100 pf.
Other condensers: 1 24 or 32 mfd 350 pv electrolytic, 2 25 mfd electrolytics, 2 .05 350 volts working.
Panel light and bezel, 5 knobs, 2 8-tag terminal strips, engraved front panel, hook-up wire, nuts, bolts, &c.

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- Uniformity . . . to ensure consistency in tracking capabilities, cartridges are given a compliance test to a minimum limit of 3.0 x 10.6 cm-dyne.
- Safety stylus—stylus tip automatically retracts under excess pressure saving both the record and the stylus.
- Simple push type sapphire styli.
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- Minimum vertical motion eliminates all traces of "needle talk" and "needle hiss".
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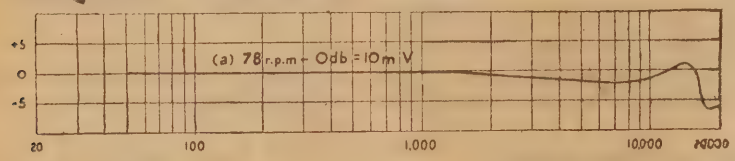
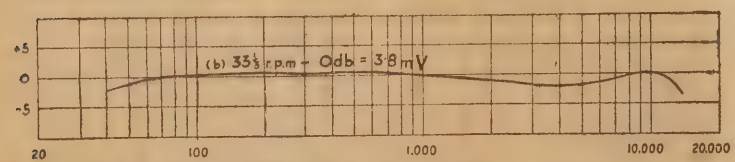
FREQUENCY RESPONSE CURVES





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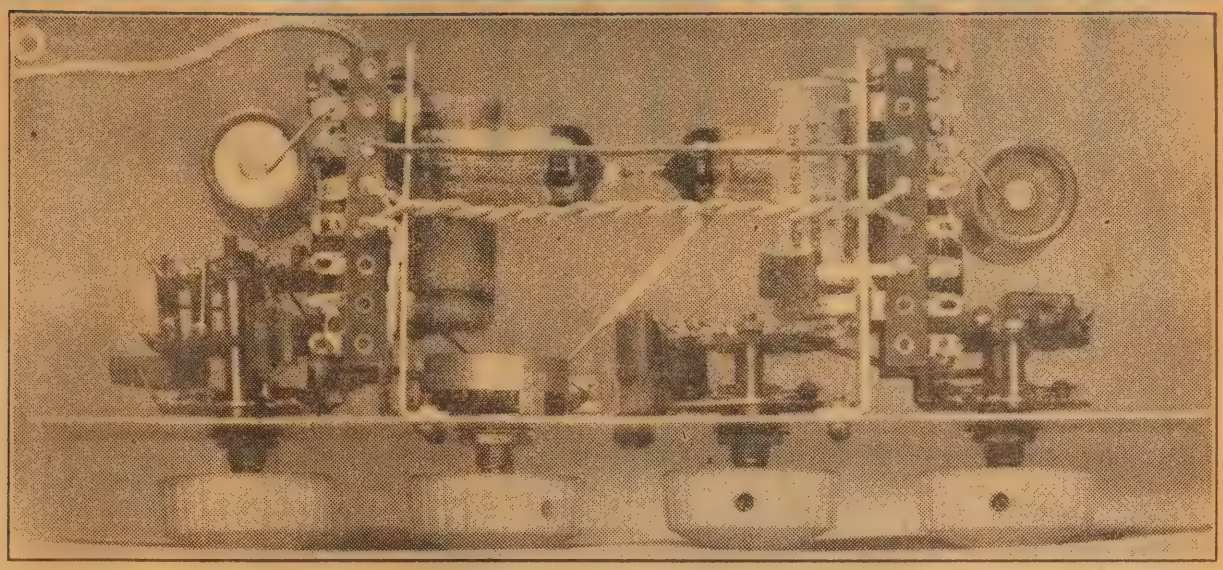
SIDE VIEW OF PLAYMASTER CONTROL UNIT SIX



The unit from the opposite side shows twisted filament leads and high tension lead between the two sections. Connections to the unit are made to the appropriate tags on the strips, with just enough length to allow the unit to be withdrawn from the cover.

well as a few spots in between did not reveal appreciable changes from the original curves.

In fact it was possible to reduce the 330,000 ohms to 250,000 ohms with still no appreciable change in response, but giving some extra gain from the stage, due, of course, to the altered ratio between the risistors in the main divider.

In any case the main change is likely to be a certain amount of roll-off on the AES curve at very low frequencies, and that won't be any loss.

If feedback is included in this stage, the effective output impedance of the valve will be greatly reduced, even with only a few db. This will make it behave more like a triode, and therefore any possible difference attributable to output impedance can still further be neglected.

At this stage the unit was built, and on test without feedback provided enough output to load a Playmaster having a sensitivity of 300 millivolts with only 6 millivolts input to the unit.

There is no point in leaving sensitivity at this figure, and the next step was to reduce it by feedback to the amount we really wanted.

Further testing revealed the fact that, using the variable reluctance pick-up as a guide we could fully load the amplifier with a sensitivity 12-15 millivolts.

The next step was to decide where to apply the feedback.

Inspecting the operating characteristics of the EF86 for conditions approximating our own, we find that distortion is only .1 pc with an input of 10 millivolts. It rises to 1 pc with an input of 100 millivolts.

LOW DISTORTION

Obviously, a good thing to do if we desire 100 millivolt sensitivity is to reduce the gain and the distortion, by using feedback with a reduction factor of 10-1. We will then return to our original distortion figure of .1 pc.

In either case, or at any intermediate sensitivity figure, the distortion from the stage will remain at this amount, provided we use the appropriate amount of feedback.

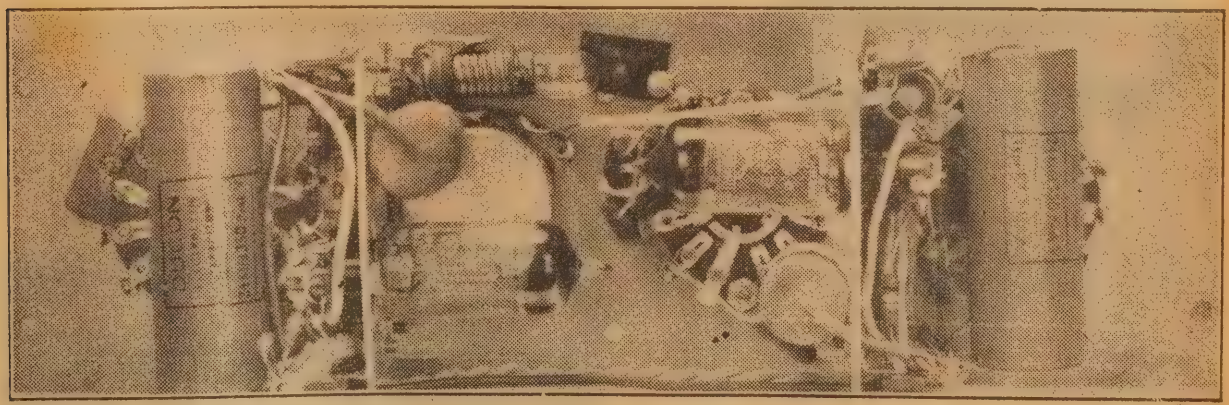
Concerning the second stage, it is designed to operate with a maximum output voltage of about 300 millivolts. Because there is a 5-1 voltage division in the divider, this means about 1.5 volts are required at the plate of the valve.

As the gain of each pentode stage is probably 100 or more, even the second valve will need only about 15 millivolts input for full amplifier output. Normally, it will run even lower than this, because it has the volume control ahead of it.

So it's a bit of a toss-up in which stage to use the feedback.

NORMAL CONDITIONS

But our readers have a habit of looking for some definition in these things, so we decided in the first instance to use about 6 db of feedback in the second stage, thus reducing overall sensitivity to about 12 millivolts. This may be regarded as the highest sensitivity normally required for the unit.



This top view shows how the two valves are staggered. The wiring to their mounting brackets is almost exactly the same. The condensers alongside the valves are screen bypasses.

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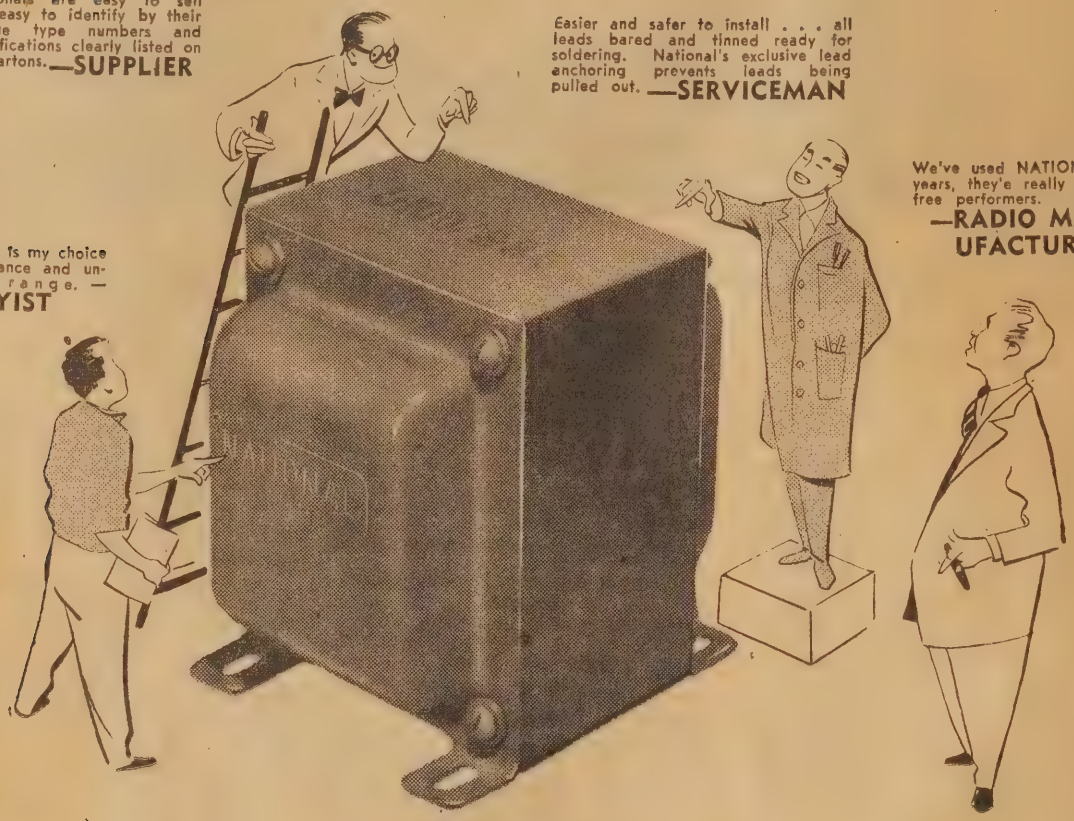

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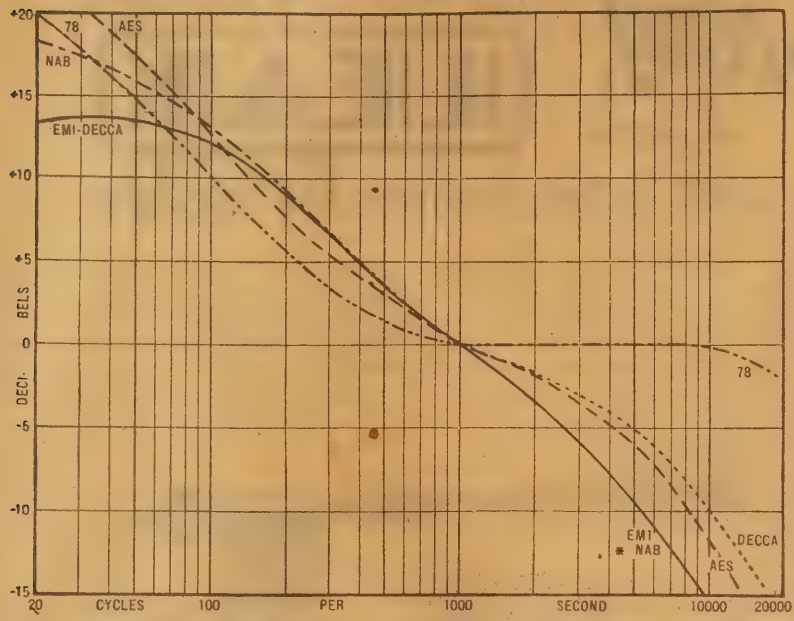

This graph shows the performance curves for the Control Unit Four, which would be identical with those for the unit described here.

The feedback is obtained by isolating the grid of the valve with a .1 meg resistor, and running a 10 meg feedback resistor from it to the plate circuit. Connection is made on the far side of the coupling condenser to avoid feeding DC to the grid.

Actually the amount of feedback will alter slightly as the volume control is operated, but this will only result in a small change in stage gain and the volume control setting takes care of this in any case.

If you find that with the pickup you have there is still too much sensitivity in the unit, it can be reduced by increasing feedback still further. A 5 meg feedback resistor will bump up the amount to about 12 db for a sensitivity of about 25 millivolts, a useful amount of feedback, reducing distortion by four times.

Or you could add feedback to the first stage as already described.

If you do this, a 10 meg resistor for feedback will give you a 2-1 gain reduction and a 6 db figure.

If your pickup is of a type which still has too much output for a 25 millivolt input, you can keep on adding feedback to the first stage by using a lower value of resistor As a reference, a 2 meg resistor will give a sensitivity of about 120 millivolts which represents a 10 times reduction, and a feedback of 20 db.

Thus, however we arrange matters, we have a particularly useful and flexible unit which, with the addition of only two resistors, will handle inputs of from 6 millovolts to almost any figure you like, enough to accommodate all the magnetic type pickups including variable reluctance and moving coil.

FLEXIBLE

It retains the simplicity of the voltage divider type of compensation plus many of the advantages of the feedback type. In practice its distortion may be expected to be not more than a fraction of 1 pc, even on peak outputs.

For purposes of calculation, of course, we have been dealing with output figures likely to be obtained from pickups using test records.

It is quite conceivable that by using a very large amount of feedback in the first stage, we could handle the output of the average crystal pickup, although, of course, we will still be faced with the difficulty that such pickups are rarely sufficiently level in their response to make the various compensation settings completely valid.

Speaking of compensation, we have retained the original settings for the selector switch because we have found them to justify their selection. It is true that the new

View of the front panel. Inscribed escutcheons are available from advertisers. From left to right controls are Bass, Treble, Volume and Selector.

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Throwing shoes for luck is only half the story. Getting married is risky business, but there's reasonable chance of success if the bride wears a borrowed garment, a bit of blue, and doesn't marry in May. But if the bridesmaids don't throw away EVERY pin in the bridal dress — down to the last one—woe betide the poor lass. Nothing will go right. It will be even worse if, on the way to Church she meets a cross-eyed woman.

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See announcement, page 66.

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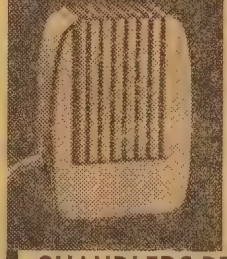

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Stylus Material: Diamond only. Stylus sizes: 0.001" radius plus nothing minus 0.0001" 0.0025" radius plus or minus 0.0001".
Record and Stylus Wear: These are lower than on any pickup of which we have cognisance.
Output: The shielded step-up transformer delivers an output of 11mV for each cm/sec. rms recorded velocity. This means that an amplifier with a sensitivity of 40mV at 1,000 c/s will be easily loaded by the pickup from commercial records.

The Arm: This is of advanced design having very low inertia. Friction is kept to a minimum by using a single pivot bearing. The arm is counterweighted and has provision for plug-in interchangeable heads. An arm rest is provided.
Dimensions: From the centre of the fixing stem to the front of the pickup head, 9¼". From the centre of the fixing stem to the rear of the arm, 2". The height of the pickup is adjustable and it can be used with any turntable.

Generating System: Dynamic (moving-coil). Coil impedance app. 6 ohms, 1,000 c/s.

Playing Weights: Between 2 and 3 grammes for LP. Between 5 and 6 grammes for 78. Automatically adjusted by the weight of the head.

The motor-board has been cut away to show the simplicity of mounting.

PRICES
The arm: £5/19/8 (retail).
LP head with diamond stylus: £12/10/3 (retail).
78 head with diamond stylus: £12/10/3 (retail).
Mumetal - cased transformer: £3/18/8 (retail).

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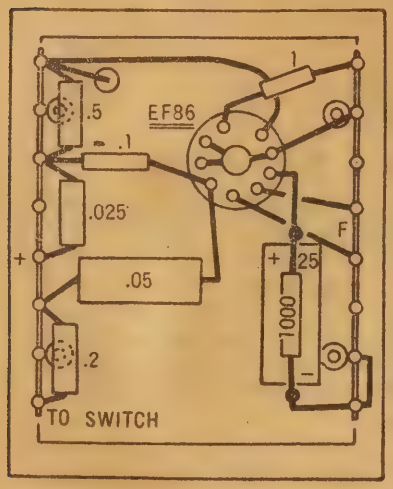
RIAA curve is not included, but it will probably be some time before it is widely used on records available here, and the AES curve isn't far out except for the extreme bass.

If you wish to include the RIAA curve, you could wire it in place of the 78 position. Most 78's sound best on the AES setting in any case, and it would not be a great loss.

VALUES FOR RIAA

We have included a small diagram showing the values suggested for this curve if you wish to make a substitution for one of those we have used, but, at the moment, it might be at the sacrifice of convenience.

Incidentally, by adding one degree of extra bass to the EMI position, you will closely approximate



This diagram shows how the components are mounted to the valve brackets. Only one has the decoupling resistor. The filament leads are brought out to opposite sides for easier connection.

the NAB curve, thus giving immediate choice of four different standards.

The extra bass control gives one degree of bass cut, and four degrees of boost, the fifth being a flat position. Each step is of 4 db.

The extra treble control has three degrees of cut and one of boost, again in 4 db steps.

The output from the unit is of reasonably low impedance—about 50,000 ohms, and ordinary braided cable is suitable for an output connection, avoiding the very fine, high capacitance type. The same cable can be used for pickup connection.

There is virtually no Miller effect loss at the mid position of the gain control, no more than about 1 db at the most.

The construction of the unit is not at all difficult, and there are no critical features about it.

Each of the switches can be wired up as a separate unit before mounting in place, as the associated components lend themselves to this method of assembly, particularly if miniature types are used. We used a variety of sizes and shapes just to show it could be done. With a little care, extremely neat and rigid units can be made.

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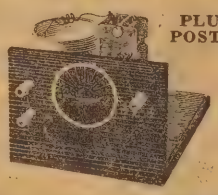

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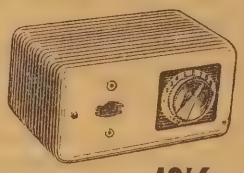

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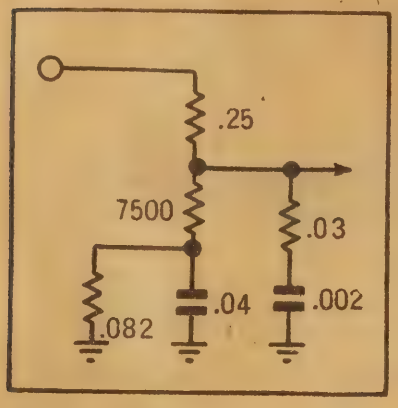
The valve brackets can be similarly wired, and they are almost exact duplicates. Only one has the high-tension decoupler, of course, and the filament connections are brought out to opposite sides so that the interconnecting lead can be kept in the clear.

The electrolytics are also mounted on the tag strips, and there is plenty of room for full sized components. We included an extra condenser across the high tension input point just for luck. It is important to have a heavy filter capacitance across this point, but it could go into the main amplifier equally well, and may be already there.

Staggering the valve positions makes certain that their tips will not collide, and gives plenty of room to mount the components. It also allows the rather large .5mfd screen bypasses to be accommodated at the side of each valve.

Holes are drilled through the



Compensation values for RIAA curve.

brackets to feed through the leads to these condensers, as well as to the grid of the second valve from the volume control, and to the switches. This practice avoids pinching leads when the cover is in place, although there is a reasonable clearance. It also makes the job firm. See that the good spaghetti insulates all such leads.

Connections to the unit are made to a five-pin socket for the radio tuner, if any, and a six-pin socket leading to the main amplifier. The leads to the unit itself are made by wires soldered to appropriate tag points, and are made just long enough for the unit to slide into the cover after they are made. The sockets are mounted on the cover.

EARTH CONNECTIONS

Note that there is no earth connection made to the filament circuit —this is done in the main amplifier. Nor is the unit, or the tuner, earthed to the amplifier except through the wires shown in the circuit. External earths will cause ground loops, and will introduce hum into the ouput.

Some of the condenser values are rather odd sizes, and you may have to make them up by paralleling more than one together. For instance, the .0013 value is made up of a .001 condenser paralleled with another of .0003. It doesn't matter if one is a paper type and another a small mica. There is no appre-

(Continued on Page 109)

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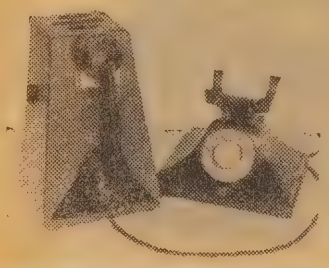

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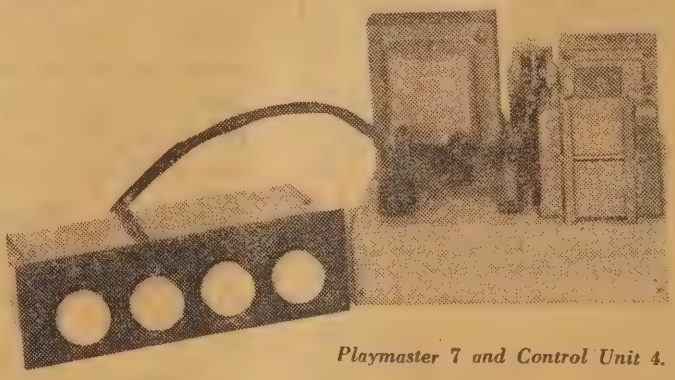

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Here's your answer, Tom!

Tom leads off his batch of questions this month with one which will be of interest to prospective amateurs. It may also be one which has puzzled enthusiasts, who have no immediate ambition to "get their ticket."

AFTER telling about a visit to an amateur's "shack" and looking through amateur handbooks, Tom poses this question:

Why do amateurs use several receivers to cover the different bands? Why not just one receiver with switched coils, like the ordinary dual-wave set?

If we could combine a spot of amateur parlance with the sentiments of a one-time popular song, we might simply paraphrase your question as "Why put all DX in one basket?"

Jokes aside, though, there are some very practical reasons why most amateurs have more than one receiver.

The most obvious one is that amateur station equipment is seldom

A monumental piece of work!

built up as a single, planned project. It only begins that way!

The amateur concerned may start up on the air with a consuming interest in overseas DX. He accordingly builds up (or buys) an extra-beaut receiver covering the bands between, say 3.5 and 30 Mc. It might be complete with BFO, be very selective or have a crystal filter, be carefully calibrated and so on, ad lib.

Some time later, he develops an interest in 50 or 144 Mc and has to find a receiver to suit. He will probably baulk at the prospect of wrecking his existing set to cover this new band, so, quite naturally, he searches around for enough parts to build a second one.

Or perhaps he buys something through disposals that can be modified. So it goes on.

Then there are some sound electrical reasons why a single receiver isn't a good proposition.

The kind of band-switching and layout which is very convenient on the lower frequency bands just isn't good enough for the VHF region. Leads are too long, capacitance figures too high, components too large and so on. Even the circuit may not be readily adaptable.

Then again, an intermediate frequency which suits a lower frequency receiver may be all wrong for a VHF superhet because requirements of selectivity, image ratio and suchlike are so different.

The net result is that amateurs either build or buy separate receivers for different parts of the spectrum or they rely on a series of converters feeding through one main low frequency receiver.

This latter idea is quite popular, because it saves money and still allows experiments to be made on a particular channel without disturbing the whole receiver, each time a change has to be made.

But a set to cover every available amateur band would be a monumental piece of work. And what a thing to service when something goes wrong and you've forgotten the circuit!

What is the best thing to use to seal cores and trimmers? Everybody seems to use something different.

You're pretty right about that last observation, Tom. We've seen them sealed with lacquer, paint, Tarzan's Grip, clear wax, even government sealing wax!

Under pain of making a further dreadful pun, one might suggest that the obvious stuff to use would be "tune gum".

In most cases, some kind of sealing is necessary, both to discourage tampering and to prevent trimmers and cores from shifting due to vibration. We've seen quite a few cases of both happening.

Radio factories frequently use lacquer type sealing compounds because they dry very hard and seal in no uncertain fashion.

Unfortunately, the "pay-off" comes when some poor, unsuspecting serviceman has to break the seal in order to realign the set after a replacement. It is very easy to break the core as well!

For home-built sets, we much prefer a thin layer of wax. It will stop vibration from affecting the adjustments but isn't too hard to dislodge when the alignment has to be touched up again. And how many home-builders aren't always fiddling with circuits, parts, alignment and so on?

Don't forget we said a "thin layer". Too much wax—or too much lacquer, for that matter—applied to trimmers, can run down between the plates and upset the capacitance.

It's rather like a certain type of sandwich spread—"too much spoils the flavor", or something.

What is the difference between modulation and mixing, as applied to transmission?

We could easily get into an argument about this, Tom, because the two terms can be used in various senses.

The word "modulation", as applied to transmitters, normally describes the process whereby audio signals (speech, music, &c.), are superimposed on the radio frequency carrier. This is usually effected in the final RF power amplifier or one of the RF amplifier stages ahead of it.

"Mixing", on the other hand, would normally refer to circuit arrangements in the radio station's control room, which allow signals from microphones, pickups, tape decks, lines, &c., to be superimposed one upon the other. By the process of mixing, an announcer can speak over music coming from a record; sound effects can be added to plays and so so on.

The various sounds are merely fed into the audio channel simultaneously, without any of them losing their original character.

In a receiver, however, we use the same term to mean something quite different. We often speak about a "mixer" valve when we really mean a frequency changer; we talk about "mixing" when we have in mind a

Seal your cores with "tune gum"

process of "beating" or "inter-modulation" or simply "modulation".

Here the incoming signal is deliberately distorted and "mixed" with the output of a local oscillator to produce a new resultant frequency—the intermediate frequency. In this sense, it infers just the opposite to its application in a broadcast studio.

A matter of usage, Tom!

In a copper-oxide rectifier, rectification occurs at the junction of the metal and the oxide. Why will current flow across the junction in one direction only?

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were prepared to treat this as one of the unsolved mysteries in life. "We don't know why, but it just does . . . &c."

Nowadays, research workers are gaining a better insight into the behavior of semi-conductors and their explanations can be reduced to terms which an ordinary enthusiast can understand. If you want to study up the whole subject, Tom, we suggest that you get hold of some elementary book on transistors. It will open up a realm of thought much bigger than copper oxide rectifiers. You'll find them grouped as merely one of a number of "semi-conducting" devices.

PRECARIOUS BALANCE

It boils down broadly to the fact that the electrical balance in some substances is rather precarious, particularly in the presence of certain impurities. Some tend to have surplus electrons in their atomic structure, others a deficiency of electrons or "holes" into which electrons can move.

When components containing such substances are inserted into an electrical circuit, electrons move most freely in the direction which tends to fill the "holes".

The ratio of forward to reverse current varies enormously with the substances involved, the nature of the junction, the temperature, applied potential and so on. The most effective "rectifiers" are those in which the current flows freely in one direction, but hardly at all in the other.

If you want to get past this mere basic idea, Tom, we suggest you go buy that book!

Come to think of it, a couple of special articles on the subject mightn't go amiss. We'll have to see!

What causes cross-modulation and double-spotting in a receiver? I do not mean image interference, which produces similar effects.

For the sake of other readers, Tom, it may be a good idea to explain all these terms and thus get the picture straight.

"Image interference" occurs only in a superhet. receiver and springs from the basic fact that the intermediate frequency is produced by the beating together of an incoming signal and the output from an in-built oscillator.

Let's take a typical example: You may be interested in receiving a local station on, say, 1470Kc, on a set having a 455Kc IF channel.

To receive the station normally the set would be tuned toward the high frequency end of the band and the station would ultimately come in with the signal circuit tuned to 1470Kc and the local oscillator to 1470, plus 455, equals 1925Kc.

However, by turning the set toward the other end of the band, the local oscillator could be reduced in frequency to 1470, minus 455, equals 1015Kc. At this position on the dial, the same station might be heard again, provided it was strong enough to penetrate the signal frequency circuits, which would no longer be tuned to it.

This second reception point is known as the "image" and is always displaced from the correct reception point by twice the intermediate frequency.

Since these points are 910Kc apart in a 455Kc superhet., image reception is seldom encountered in such a receiver on the broadcast band. It used to be quite a problem, some years ago, when superhets. were in vogue, having intermediate frequencies around 175Kc.

Even with a 455Kc superhet., however, image reception is very apparent on the shortwave bands, as you have probably noticed. Strong shortwave stations come in at two distinct points on the dial separated by some 930Kc.

"Double spotting" is simply another name for "image reception".

"Cross-modulation" is quite a different effect, which may occur in any type of receiver, TRF or superhet. It happens this way:

Let's say you live quite close to a powerful station on 1000Kc. You can tune to it normally and likewise reject it by tuning the receiver away from it. On the surface of things, the receiver appears to be quite selective enough to deal with the situation.

EFFECT ON FIRST VALVE

However, what you may not realise is that the signal is rejected, not just by one tuned circuit but by a whole series of them. Thus, while the strong signal may be excluded from the detector and audio system as you tune away from it, it may nevertheless be still very strong at the grid of the first valve.

Now let's say that you tune to another signal on the band. The first valve now finds itself with two signals on the grid—(1) the new signal you've just tuned in, and (2) the signal you've rejected.

Only the wanted signal should be amplified, however, because the rejected signal should still not be able to pass through the subsequent tuned circuits. Only the desired signal should be heard in the speaker.

However, if the first valve is markedly non-linear in its operation, or if either signal is strong enough to swing its grid into a curved portion of the characteristic, a certain amount of intermodulation may occur between the two signals. As a result, some of the speech or music from the unwanted carrier will find itself impressed on the wanted signal and two lots of programs heard in the speaker.

OLD TIME COMPLAINT

Unless you know it, Tom, the effect can be a very puzzling one, because it seems at first glance like a case of poor selectivity. However, it obviously can't be that, because the interfering signal does not spread across the dial; it only appears as a background when certain other stations are tuned in.

It was a particularly "popular" complaint around about 1930, when people still had to use fairly large aerials in the suburbs and fed them into sharp cut-off valves like the 24. Due to their short grid base, they were easily pushed into the non-linear region by signals fed in through a big aerial and a not-too-efficient tuned circuit.

Nowadays, the first valve in a receiver is invariably a remote cut-off type, lacking any regions of abrupt curvature. Tuned circuits are more efficient, aerials are normally smaller in strong-signal areas and cross-modulation is not much met with.

However, it can still happen, Tom.

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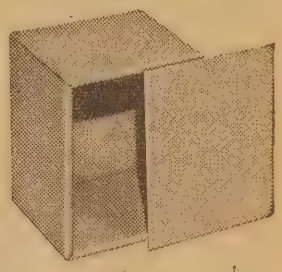

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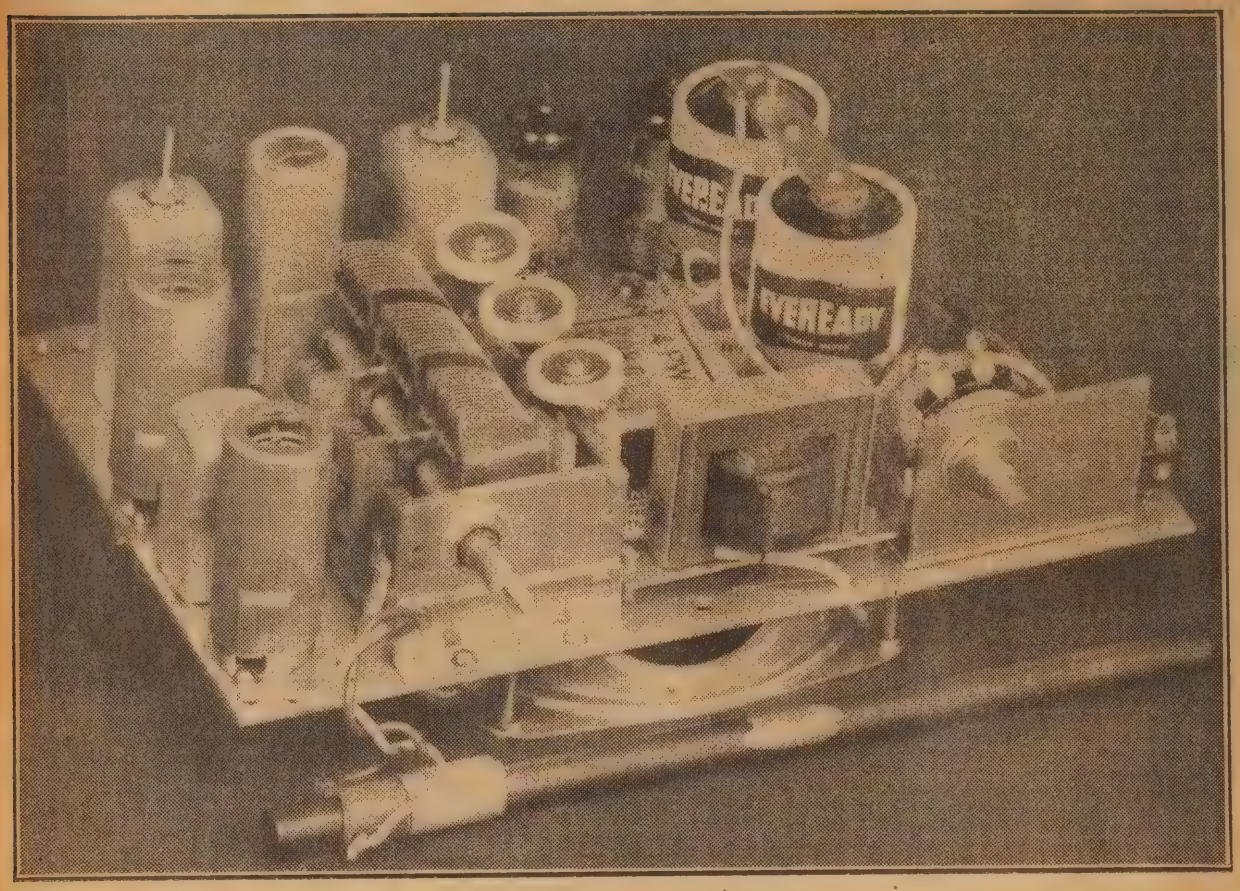


A front view of the completed receiver ready to be slipped into the cabinet. The speaker may be seen under the chassis and behind the rod aerial. Left of the gang is the RF valve, RF coil, and converter valve. First IF transformer, IF valve, and second IF transformer are along the rear of the chassis.

A LIGHT-WEIGHT PORTABLE SET

Thinking about a portable this summer? If so and you want something smaller than our recent designs, but which will still bring in plenty of signals, then this is the set for you. Using an RF stage, a Ferrexcube rod aerial and a new four-inch speaker, it will be hard to beat for its size, either for its volume or its ability to tune in stations.

by Philip Watson

IN setting out to design this set we had a definite objective in mind: namely, a set which was smaller and lighter than, say, the "Rambler", yet retaining as much as possible of the performance of a set in this class.

In particular, we were keen to retain the high overall sensitivity of the larger set, even though we knew we would have to sacrifice something in the way of audio output and battery life as the size was reduced.

It seemed to us there was need for such a set. While not truly in the personal portable class it should still be small enough and light enough to carry virtualy anywhere, yet pack enough punch to bring in stations, even in difficult locations.

After all, the ability to get stations is of prime importance and most users will overlook other limitations if they can hear the station they want, when and where they want it.

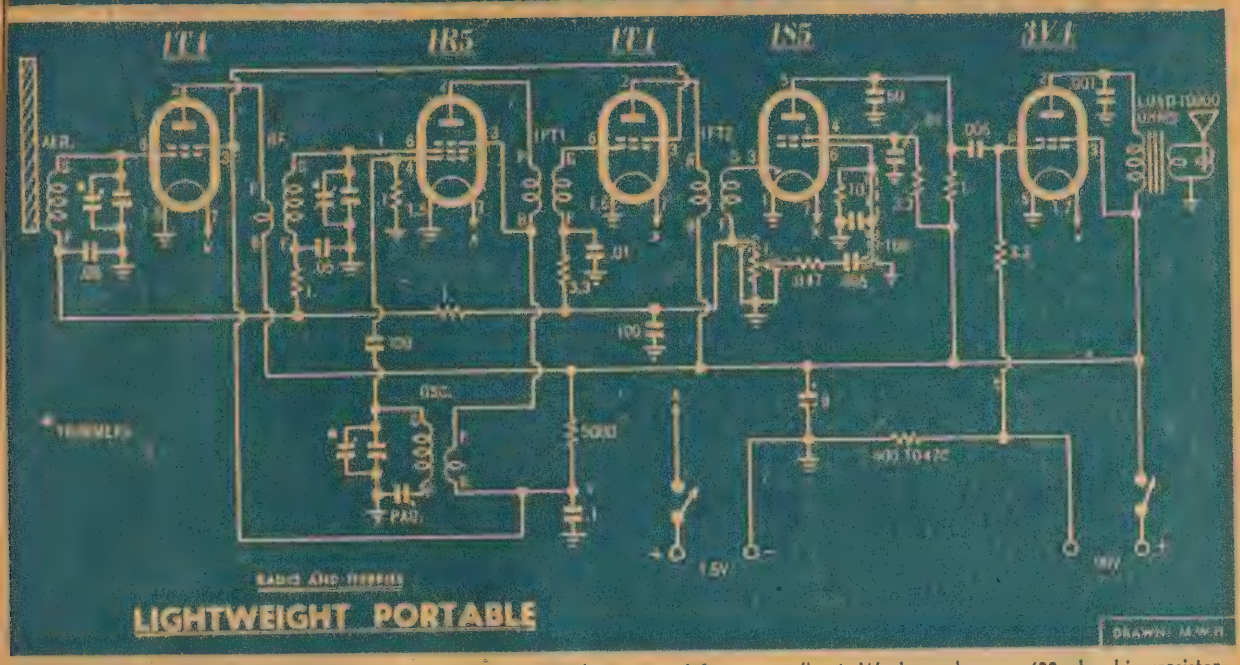
In mentioning the "Rambler" we do not wish to suggest that this design in any way supersedes it. For its size, the "Rambler" is one of the best sets we have yet produced, combining high sensitivity, good audio output, and relatively low running cost. It would be difficult to produce anything smaller which would retain all these features.

But if you are prepared to accept a trifle less audio output and a slightly higher running cost, you can have a much smaller set which can still put up a very impressive performance.

Tested on the roof of our building in daylight we had no difficulty in driving the output stage to overload with signals from 2KA and 2CR. 2WL could also be heard, though at rather less volume. At night there are plenty of NSW country and interstate stations which can be heard at good speaker strength, using only the in-built aerial.

From a purely technical point of view, the design was prompted by a number of new components which

RF STAGE AND NEW AERIAL GIVES HIGH GAIN



The circuit is quite standard, though rather more sensitive than is usual from a small set. We have shown a 400 ohm bias resistor but it may be increased to 470 ohms to give lower battery drain, provided the loss in power output can be tolerated. Performance at the higher frequencies can often be improved by connecting a small capacitor (5 to 8 pf) between the "G" and "P" terminals on RF coil.

have appeared in the past 12 months or so, and which solve some of the problems previously presented by a design of this kind.

Probably the most important of these is the Ferroxcube rod aerial, which has been developed to replace the conventional loop. These new rod aerials have a signal pickup equal to all but the largest loops, and, consequently, are of most value in small sets which previously suffered a severe loss of signal pickup by reason of the small and inefficient loops which they were forced to use.

Next, there has recently been released a 4-inch speaker, which has obviously been prompted by the need for something intermediate between the tiny 3-inch and the larger 5-inch types. It is by the use of this speaker

MINOR COMPONENTS

Finally, there has been considerable improvement in the design of minor components. The advent of metallised paper capacitors, as well as improved designs in the paper types, and the availability of voltage ratings more in keeping with battery operation, has resulted in considerable reduction in size without any sacrifice in efficiency.

Resistors have likewise undergone a change for the better, and the new BTS type half-watt unit is only a fraction the size of its predecessor of the same rating.

When we considered all these facts we decided that it would be perfectly feasible to produce a set which retained the features we required, but which would be considerably smaller than anything of similar performance which we had yet offered.

Reference to the circuit will give some idea of how we achieved it. Most important is the retention of the RF stage, something which is generally dropped in the very small portables. Another point is the use of a 90-volt HT battery in place of the more conventional 67.5-volt type. This not only helps with the overall sensitivity, but also improves the power output from the 3V4, which may be run close to its maximum ratings.

This fact, coupled with the larger speaker, makes possible a greater undistorted volume than is normally obtainable from a small portable.

The filament circuit gave us some food for thought. First, we had to decide whether to use a series or parallel filament arrangement, and then what type of battery to use. The series arrangement has the advantage that the system lends iself more readily to AC operation.

Against the arrangement is the need for a more complicated filament network, with several rather bulky capacitors which have to be accommodated somewhere, and the need to use a 9-volt filament battery. This latter point was the main stumbling

PARTS LIST

- 1 chassis 8½in x 5½in with volume control and gang brackets
- 1 4in speaker with 10,000 ohm transformer
- 1 Ferroxcube rod aerial
- 1 midget RF coil
- 1 midget oscillator coil on .1 meg. resistor
- 2 455 Kc midget IF transformers
- 1 1T4 valves
- 1 1R5 valve
- 1 1S5 "
- 1 3V4 "
- 3 7 pin miniature shielded sockets
- 2 7 " " plain sockets

CAPACITORS

- 1 8 mfd 125 VW electrolytic
- 1 .1 mfd 200V paper
- 2 .05 mfd 200V metalised paper
- 2 .01 " " " "
- 2 .005 " " " "
- 1 .001 " " " "
- 1 adjustable padder (400 pf approx.)
- 1 midget 3 gang with vernier drive and dial plates
- 3 100 pf ceramic
- 1 50 pf "
- 3 trimmers

RESISTORS

- 1 10 meg. ½W midget
- 3 3.3 " " "
- 3 1 " " "
- 1 1 " potentiometer and switch
- 1 .047 meg. ½W midget
- 1 5000 ohm 1W
- 1 400 ohm ½W midget (or 470 ohm)
- 1 battery plug suit 490P
- 1 3 terminal tag strip
- 1 4 " " "
- 1 7 " " "
- 1 8 " " "
- 4 1in x ⅛in counter-sunk screw
- 1 1¼in x ⅛in round-head screw
- aluminium for battery strip and chassis plate
- 2 950 cells
- 1 490P battery
- shielded hookup wire
- 1 insulating pillar 1in long, tapped ⅛in
- 2 small knobs
- hookup wire, tinned copper wire, spaghetti, sleeving for shielded hookup wire, nuts and bolts, solder lugs, &c.

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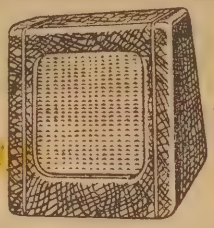

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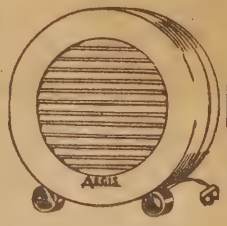

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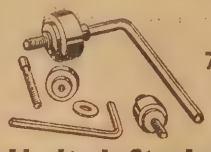

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block, since there is no readily available battery of suitable size.

The parallel arrangement does not provide any bias, which has to be subtracted from the HT battery voltage, and does not lend itself so readily to AC operation, though it is by no means impossible. On the other hand, the wiring is very much simpler, several components are saved, and the system may be powered by two flashlight cells in parallel.

This last point was one of the main deciding factors and we settled for the parallel arrangement.

In deciding on the most suitable type of battery we considered several possibilities, finally narrowing the choice down to a pair of 950 cells in parallel or a type X71, a square cell fitted with two screw terminals.

NOT SO GOOD

We were keen on this latter for two reasons, one its shape, which was very convenient, and the other the screw terminals which would make fitting somewhat easier. However, a few words with the battery manufacturers soon altered the picture. The X71 would give about the same life as two 950 cells — or perhaps a little less — and would cost about a shilling more, plus the fact that it is not nearly as popular as the 950, which can be purchased almost anywhere.

On these facts we settled for two 950's in parallel and devised a simple method of holding them on the chassis. They should provide about 10 hours of life, more or less depending on the ratio of operating time to rest time.

The choice of HT battery was fairly obvious, the type 490P being about the ideal compromise between size and weight on the one hand and operating economy on the other. It should give about 40 hours of life on a basis of two hours operation per day.

For the gang we chose one of the midget variety having a built-in vernier drive. This simplified the dial problem, in terms of both cost and space, the gang being supplied complete with pointer, dial scale and a matching scale for the volume control.

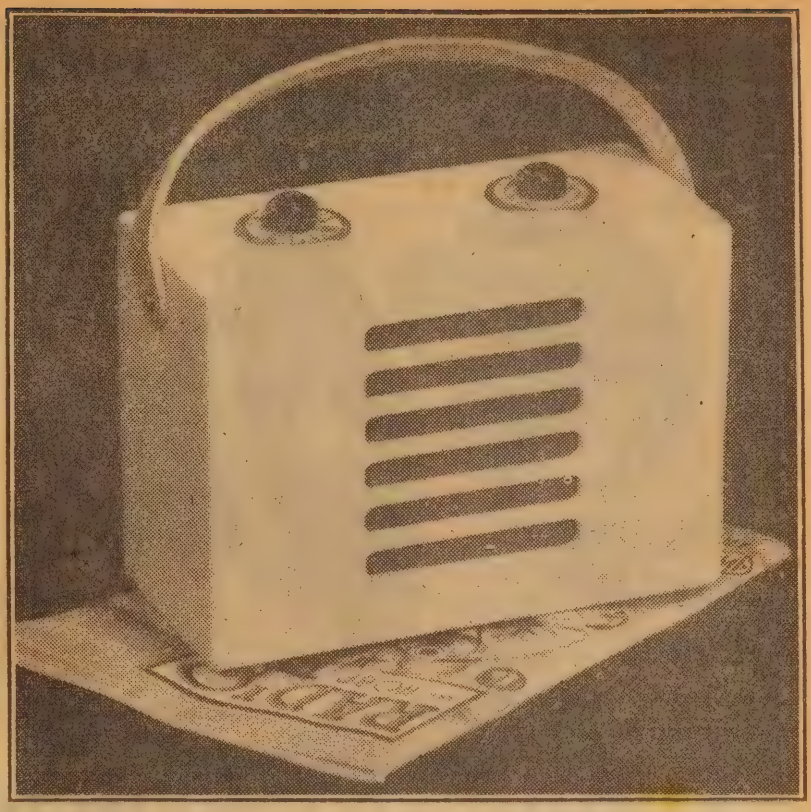
Most of the capacitors are of the metalised paper variety, the two exceptions being the .1 mfd, which is a very small 200-volt paper type, and the 8 mfd, which is an electrolytic. Even this is quite small, being rated at 125 peak working volts, and measuring ½in in diameter and 1 7-16in long. Anything appreciably larger than this may be difficult to accommodate.

With the exception of the 5000 ohm all resistors are of half-watt rating and may be of the very small type now available. However, it is likely that the older type can be squeezed in if necessary.

STANDARD PARTS

The remaining components called for no special consideration, the coils and valves being standard miniature types, and the switch potentiometer being a standard type, since there is plenty of room for it.

The chassis consists of a simple flat plate. When mounted in the cabinet it is supported by a small wood block at three of the corners,

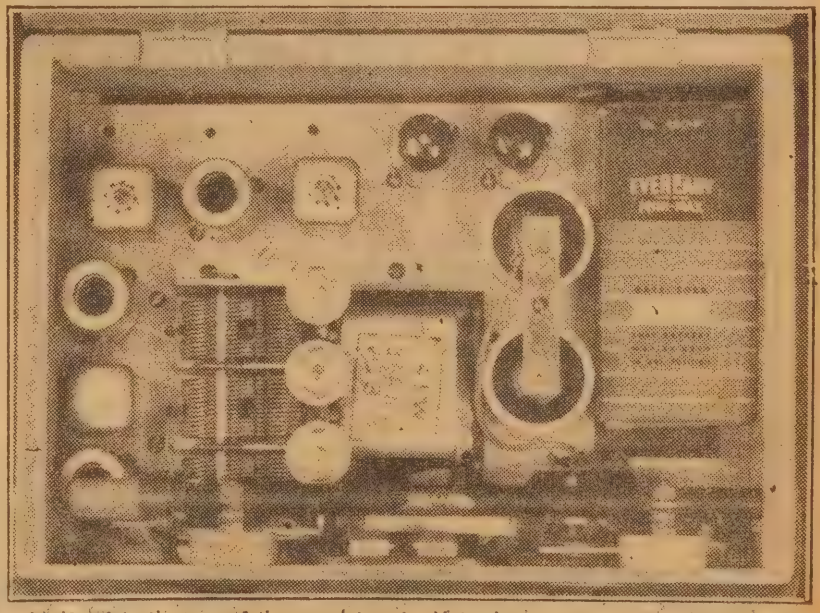


The complete set in its cabinet. Constructional details are given elsewhere and the job may be finished in leatherette instead of enamel as in this case. The handle may be of leather or plastic according to taste.

and, when on the bench, it rests on the speaker mounting bolts. These keep all components, including the speaker, clear of the bench and the set may be handled as one complete unit.

The layout provides for the speaker to be mounted underneath the chassis, approximately central, and with the magnet housing passing through a cut-out and occupying otherwise unused space above the chassis.

The depth of the speaker under the chassis is thus reduced to about three-quarters of an inch, the addition of the baffle bringing it close to one inch. Since the baffle is only as wide as the speaker, there is ap-



Looking into the rear of the complete set. Note the mounting position for the rod aerial and the small blocks to bring it clear of the case catch. The chassis block near the volume control also serves as a wedge for the HT battery.

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oximately one inch of depth on ther side to accommodate components. This is more than sufficient, e deepest being the oscillator coil ounted over the 1R5 socket, but en this should clear the case by at ast one-eighth of an inch.

The major components are group- l around the speaker in logical or- er. In the front left-hand corner the RF valve, behind it the RF coil, en the 1R5 converter. The front ction of the gang tunes the Ferrox- ube aerial coil, the centre section unes the local oscillator, and the ear section the RF coil. This rrangement not only makes for nort leads and convenient compon- nt layout, but also minimises the oupling between the aerial and RF ections of the gang.

Along the rear of the chassis is he first IF transformer, the IF am- lifier, the second IF transformer, and he 1S5 and 3V4, which constitute he audio section. To the right of he speaker housing are the two 950 ells and on the front of the chassis he speaker transformer. To the right f this is the volume control and attery switch.

ASSEMBLY

In mounting these various components above the chassis there are a few points to watch and we will deal with them in detail.

The screws to support the speaker should be mounted first, since they will be covered by the gang and volume control bracket. These are countersunk screws, at least 1in long, and may need to be trimmed subsequently. The one nearest the 3V4 valve also holds a three-terminal tag strip, which should be fitted at this stage. Its height should be reduced by bending the mounting terminal flush with the insulating material.

Check the mounting of the speaker at this stage and adjust the screws slightly by bending if necessary until the speaker slips on to them without difficulty. In no circumstances should any strain be placed on the speaker frame when it is finally fitted.

The gang is mounted on its side, and this means that the brackets supplied with it are not suitable. You will have to bend up a couple from scrap aluminium if they are not supplied with the chassis.

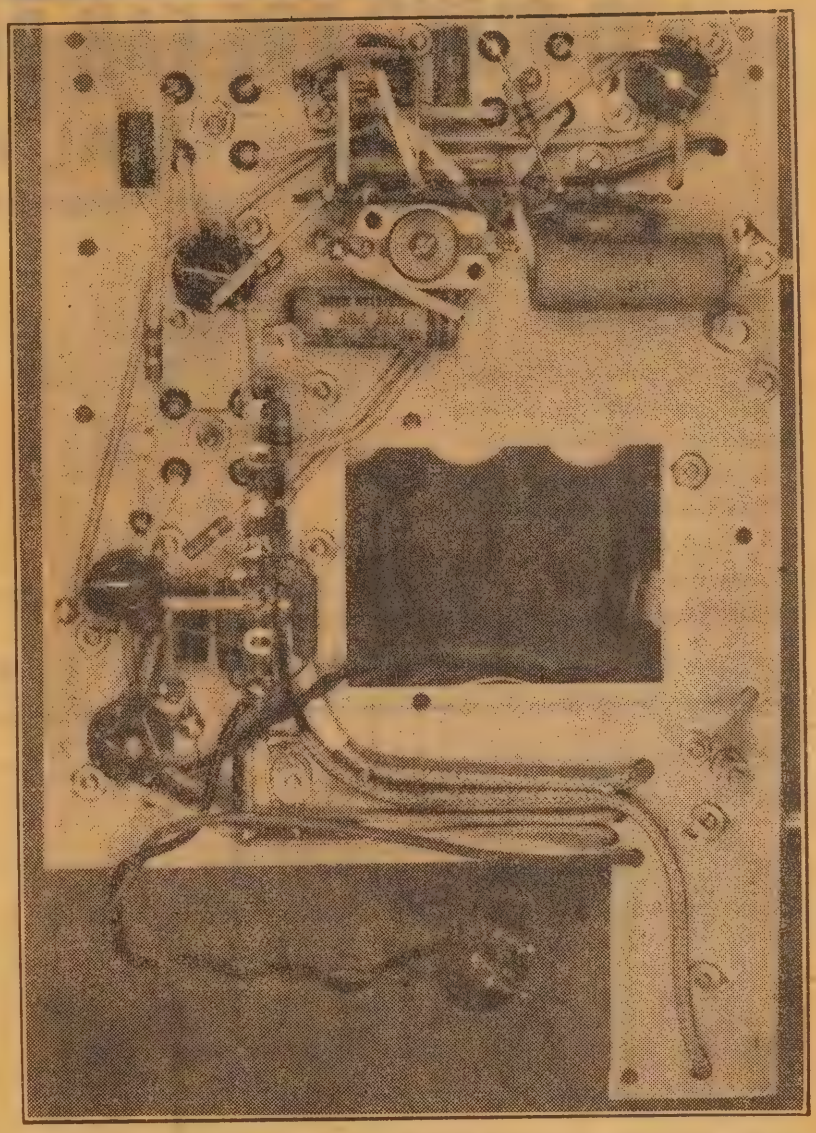
The mounting holes on the gang are normally tapped 1-8in Whit., but in some cases not all the holes may be processed. In this case you will have to either tap them yourself or, if this is not possible, drill them to a clearance size and fit the bracket with a nut and bolt. Make sure the bolt is no longer than necessary, otherwise it may foul the fixed plates and may even force them out of line if screwed up tight.

Make sure that the gang sits firmly on the chassis, and adjust the holes on the mounting brackets if necessary. If this is not so, the gang shaft will not be central in the cabinet hole.

TRIMMERS

The trimmers are soldered on to the gang frame, making sure that the screw side is earthed, and need to be placed with some care. They must not foul the moving plates when these are rotated, and must also be so placed that the aerial trimmer is clear of the aerial rod when this is in place on the cabinet. To make sure on this point the fitting of the trimmers should be left until the set is almost complete and can be checked in the cabinet.

UNDERNEATH VIEW OF THE SET



View of the completely wired chassis before the speaker is fitted. Top right is the RF valve and below it the RF coil and converter valve with oscillator coil. Small electrolytic and padder are on the right of the tag strip.

The speaker transformer will probably be supplied fitted to a small bracket having two stand-off pillars. This bracket will be too long as it is, and the longest section needs to be cut to the same length as the shorter side. The pillar is salvaged from the discarded section and used in conjunction with a new mounting hole.

The volume control bracket is set back from the front of chassis to allow clearance for the mounting nut and lockwasher, and this point should be checked and the mounting holes filed if necessary. A four-terminal tag strip mounts to the right of the volume control by one of the bracket mounting bolts.

The two 950 cells sit upright on the chassis, thus completing the negative circuit automatically. The positive circuit is made by means of a metal strip pressed against the two positive contacts and held in place with a central screw. This screws into an insulated pillar mounted on the chassis between the two cells, and the length of the screws are so chosen that there is no risk of shorting the positive side to chassis.

The positive contact strip may be a piece of aluminium or brass and should be fairly heavy gauge. A hole should be drilled in each end to accommodate the small pip on the positive cell contact and allow the strip to rest flat. A length of hook-up wire runs from the strip to the switch.

If an aluminium chassis is used the cells may rest directly on it, but a steel chassis will not provide very good contact. In this case it would be wise to fit a plate of aluminium or brass on which the cells may rest, and which shoud be wired into the earthing system of the set.

The next stage of the assembly is

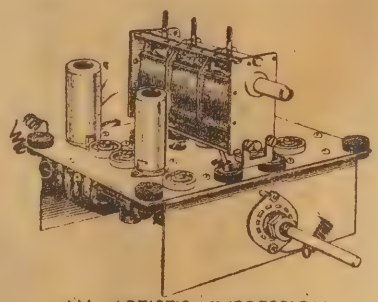
ANOTHER "Q-PLUS" PRE-FAB RELEASE

THE DWRP-5 DUAL WAVE UNIT

THE LITTLE BROTHER TO THE NOW FAMOUS TRIPLE-WAVE UNIT

Now you can build a sensitive dual-wave receiver without expensive equipment.

Unlike the normal dual-wave unit this unit achieves a new stability and sensitivity due to shorter leads (leads are now taken direct instead of via terminal strips and ill chosen positions).



AN ARTIST'S IMPRESSION OF THE NEW UNIT

DWRP-5 — Uses 6BA6 RF Valve 6AE8 converter.

FREQUENCY-COVERAGE SWITCHING

535 Kcs—1630 Kcs.

16-50 M. and Gramo.

YOU SUPPLY THE IF AND AUDIO — WE SUPPLY THE "FRONT END."

Remember, you buy not only a tuning unit but 3 gang AWA condenser, all sockets, condensers, resistors, etc., for the front end of a sensitive wireless.

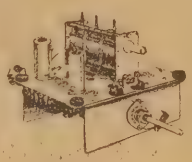
FURTHER TRIPLE WAVE DETAILS

"Q-PLUS" PRE-FAB TUNING UNIT TYPE TWR5 PAGE 1

A triple wave and gramo tuning unit, pre-wired and pre-aligned.

SWITCH POSITIONS

1. (Max. anti-clockwise) =pick-up consisting of 3 sets contacts on reverse side of each switch wafer.
2. 535 Kcs.—1630 Kcs= B/C.
3. 2.8 Mcs.—8.0 Mcs.= Medium band.
4. 7.5—23.00 Mcs Short Wave Band.



Chassis Mounting.—The unit is designed to fit on the right-hand side of a chassis with the IF transformers and valves running along the back to the audio and power sections which are adjacent to the unit.

A cut-out 6in x 5in is necessary (5in deep commencing right at the front of the chassis) and 6in long. 4 holes with centres 4½in and 6¾in apart respectively will accommodate the prefab. unit, which comes with rubber mounting grommets.

Valve Types.—The TWR5/1 unit requires the addition of 1 type 6BA6 valve and 1 type 6AE8.

Dial.—The EFCO dial type no. USL46 is designed for use with this unit.

Wiring Code.—From back hole nearest corner.

Blue=IF plate.

Red=B+ 250 volts.

Green=AVC supply.

From back hole near middle.

Green=Filament supply 6.3 volts. other lead through earth.

Red=Screen supply. See later note.

"Q-PLUS" PRE-FAB TUNING UNIT TYPE TWR5 PAGE 2

Red lead from front near switch=aerial.

Sensitivity.

With one stage IF amplification sensitivities of less than 1 micro-volt were obtained on the B/C band, whilst the sensitivities on the other band were as follows:—

Medium band.

3.00	M/cs.	2 uV
5.00	M/cs.	1.5 uV
8.00	M/cs.	1.2 uV

Short-wave band.

8.2	M/cs.	4 uV
14.0	M/cs.	4 uV
21.0	M/cs.	2 uV

Alignment.—As previously remarked the alignment of this unit is complete and no further adjustment should be necessary.

IF Types.—In the standard size "Q PLUS" IF 8 and 9 or in the miniature size "Q PLUS" 1 and 2 are the most suitable types.

Screen Supply.—Recommended supply is from 250 volt B+ source through 30,000 W. 2-watt resistor. + bled by 30,000 W. 1-watt resistor. See circuit.

N.B.—A separate screen supply source is needed for IF channel.

R. W. STEANE & Co. Pty. Ltd., Auburn, Vic.

he mounting of the valve sockets, oils and tag strips. The correct rientation of the sockets and coils s most important if short logical wiring is to be achieved. The layout liagram gives all this data and it hould be studied carefully at this tage. It also indicates where earth oints are likely to be made, and older lugs should be mounted under nearby mounting bolts as they are itted.

Before mounting the IF transformers, check the adjusting screws. It sometimes happens that the core is jammed in the winding former, and any attempt to force it will result in breaking the brass screw away from the core. If in doubt, return the unit to your dealer before you do any damage.

DOCTORED TAG STRIPS

There are two more tag strips to be fitted, an eight-terminal type near the RF end and a seven-terminal type near the audio section. Miniaturised tag strips seem to be the one component missing at the present time, and so some doctoring is called for. The seven-terminal strip is mounted under the speaker and would foul it in the normal way. To overcome this, the central mounting terminal is bent flush with the insulating material, thus allowing it to mount against the chassis, and the top of each terminal is bent over at right angles away from the speaker.

Now the wiring may be commenced. If using a steel chassis, first connect together all the solder lugs and tag strip earth terminals, using about 18-gauge tinned copper wire. It is unwise to trust to a steel chassis for a return circuit.

Next, join together at each socket all those pins which are to be earthed and connect them to the earthing system. Don't forget the central spigot which acts as a shield. To make use of the hole or slot normally provided in this spigot the latter may be rotated if necessary by means of a pair of pliers.

Now the filament lead may be run, this consisting of a single lead joining all the positive pins and running to the appropriate contact on the switch. Make sure that the insulation of these leads is run well up to the various contact points in order to eliminate any risk of accidental connection to a HT circuit.

Wiring is most easily carried out, using hook-up wire for the longer runs, such as the filaments, AVC, &c., and tinned copper wire in spaghetti sleeving for short straight connections, as from a valve pin to a nearby coil connection.

Care should be exercised when wiring the oscillator coil, the leads from it being very fine and easily broken. The coil is wound on a .1 meg. resistor which becomes the 1R5 oscillator grid resistor and this is mounted by connecting the resistor between pin four and chassis.

OSC. COIL WIRING

Of the four leads from the oscillator coil the "Osc. plate" may be taken direct to pin three of the 1R5. The other three are terminated on the tag strip, the "B Plus" going to the 5000 ohm resistor, also mounted on the tag strip. These leads should be protected with spaghetti sleeving to guard against mechanical damage, as well as short-circuits.

The padder is also mounted on this tag strip, two short lengths of 18 gauge tinned copper wire serving to hold it quite firmly. We chose to use an adjustable padder because the oscillator coil is fixed in value and some form of adjustment is desirable to ensure correct tracking with the dial calibrations.

Two resistors which need to be carefully placed are the 1 meg. and 3.3 meg. AVC resistors. These need to be mounted as close as possible to the second IF "F" terminal. It is not always appreciated that this end of such resistors is "hot" and that the other end, being bypassed by the AVC capacitor is "cold". Thus the leads at the "hot" end should be kept as short as possible.

For the same reason, as well as to prevent hum pickup in certain circumstances, the leads to the volume control should be shielded. Where the shielded lead runs near the terminal strip it should be encased in a length of plastic sleeving to prevent short-circuits. The .047 decoupling resistor, .005 mfd. coupling capacitor, and the 100 pf bypass are mounted on the tag strip near the volume control.

When all the wiring is completed and carefully checked, the speaker may be fitted. It is held on to the mounting screws by two nuts at each corner and the position of these should be adjusted carefully until the correct height is achieved and the speaker sits squarely in place.

Before applying power, the filament circuit should be carefully tested against HT shorts. Since it is quite easy to blow a complete set of valves if there is a wiring error, this precaution is essential.

FILAMENT CHECK

With the filament battery connected, but leaving the valves still safely in their cartons, go over the filament circuit with a volt-meter and check that voltage is applied to each set of socket pins. Next, still without the valves, connect the HT battery and check the filament circuit again to make sure that there is still only 1.4 volts applied to the filaments. Use a high meter range at first, just in case.

If all is well, you may now fit the valves, secure in the knowledge that they should be quite safe. If you have no meter you can still check the circuit in much the same way, using a low voltage torch globe in its place. If the globe burns out when the HT battery is applied, look for trouble; and don't put the valves in the socket until the circuit will pass this test.

With the valves fitted the set should show some signs of life and a few stations should be audible. However, correct alignment is essential and this is the next step. We have available pamphlets on alignment which cover the subject in detail, so we will confine our remarks to those aspects which are peculiar to this set.

If at all possible obtain the use of a signal generator, at least to align the IF channel. Once this is done it is relatively easy to complete the job with reasonable accuracy, using signals from broadcast stations. If a generator is not available the IF channel should be left untouched until the RF section is adjusted.

Regardless of whether you use a signal generator or station signals for the RF adjustment, the procedure would be as follows: Fit the set temporarily in the cabinet and set the dial pointer to the low frequency end of the dial. (Lying across both the dial mounting pins will be about right.)

Now rotate the gang until the pointer rests on the 2FC marking (or the equivalent in other States), slip the pointer off the shaft and take the

(Continued on Page 108)

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MICROPHONES & ACCESSORIES

TYPE 44
Price
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Hand or desk mounting, counter balanced base, ivory plastic housing.
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17 LEIGH ST., ADELAIDE,
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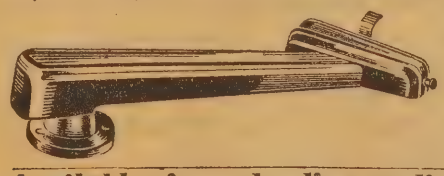
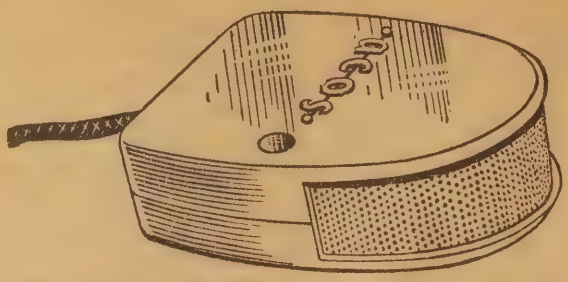
The **GP10**, utilising the **GP9** cartridge, incorporates a unique flexible assembly which renders the crystal virtually unbreakable. A novel beryllium copper spring enables needle pressure adjustment to suit user's preference. Combines purity of production with extreme reliability. Resonance-free response from 50/8000 c.p.s Output 1.5V at 1000 c.p.s.

£3/12/6
Available from leading radio houses everywhere



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ACOS MIC 35 (HAND AND/OR DESK TYPE)

AT THE AMAZING PRICE OF

£2/15/0

A general purpose microphone with high sensitivity and substantially flat characteristic. Housed in attractive Die Cast Case of very robust construction is particularly suitable for use in recording apparatus — Public Address Equipment — Dance Bands — and similar applications.

Provided with built-in shunt resistance of 2 megohm giving response substantially flat from 50/5,000 cps. Resistance of the input circuit will reduce the low frequency response. A grid leak of ½ megohm will reduce the output at 500 cps by 3 dbs and pro rata at lower frequencies.

Approximate capacitance of the microphone is 750pF and cable capacitance will reduce output proportionately.

Frequency response	Substantially flat from 50/5,000 cps.
Output level	= 55 db ref. 1 volt/dyne/cm2.
Load resistance	2 megohms included.
Cable	This microphone is supplied with approximately 4ft. 1.2 metres of co-axial cable (type Unirad 32).
Weight	Microphone only — 6oz. (approx. 170 grammes) complete with packing 7oz. (approx. 198 grammes).
Dimensions	Microphone only 2 7/8in x 2 1/8in x 7/8in plus cable. Complete with packing 3 3/8in x 2½in x 2¼in.

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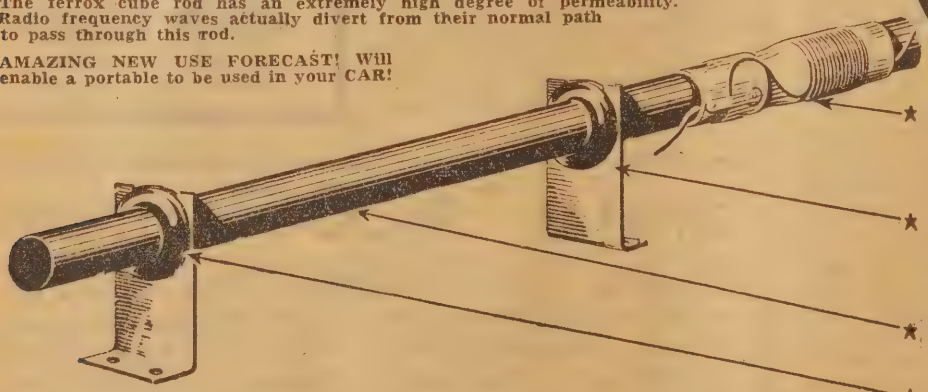

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★ ALUMINIUM MOUNTING BRACKETS

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★ QLD.: CHANDLERS Pty. Ltd., Cnr. Albert & Charlotte Sts., Brisbane.
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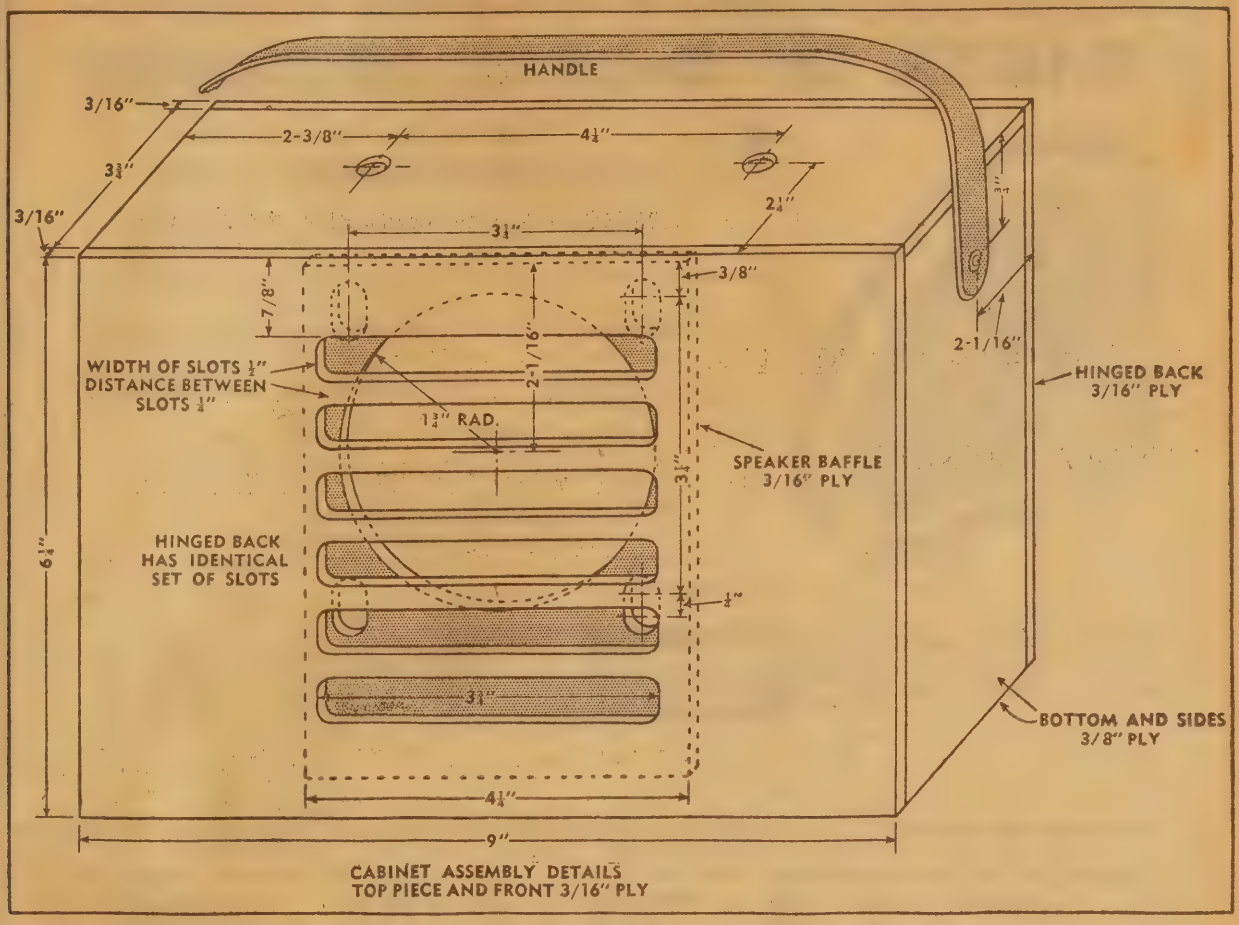
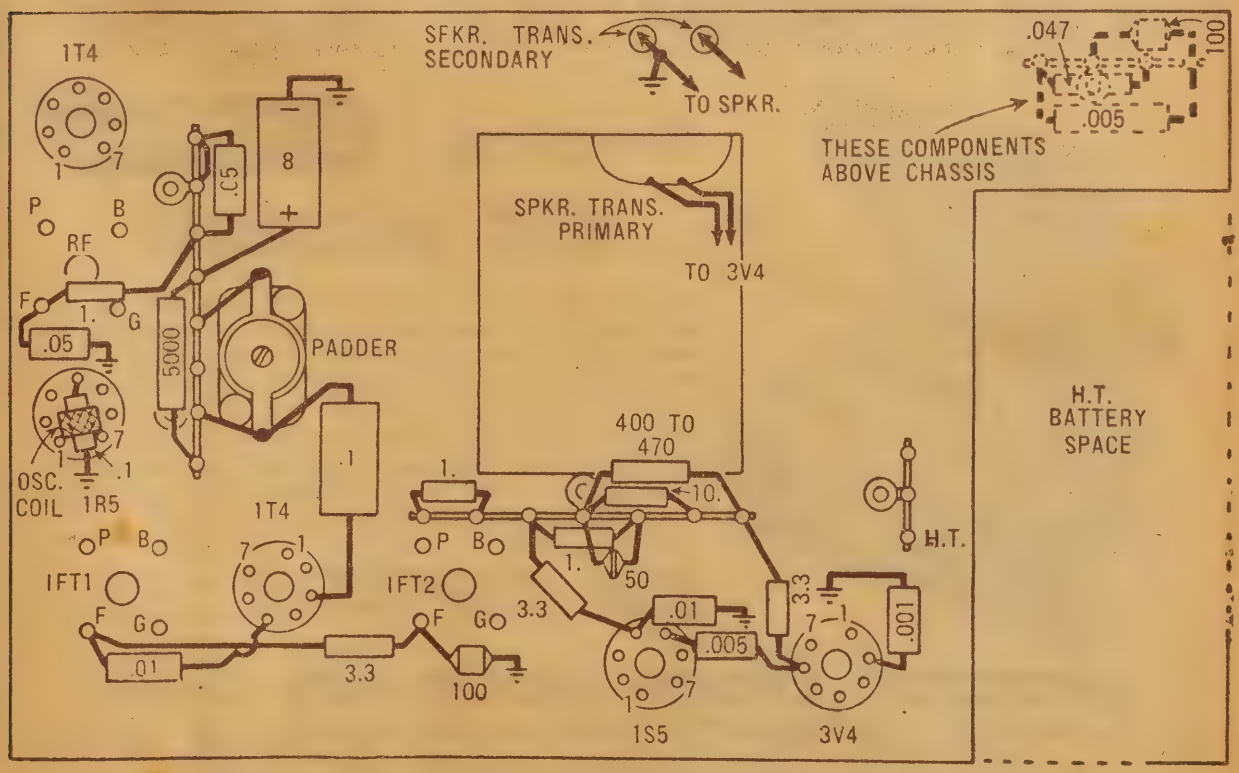
CHASSIS AND CABINET DETAILS FOR NEW PORTABLE



This drawing gives all cabinet dimensions for those who would like to make their own. Finish in either enamel or leatherette.



This layout diagram shows the position of all the components and the mounting of the resistors and capacitors.

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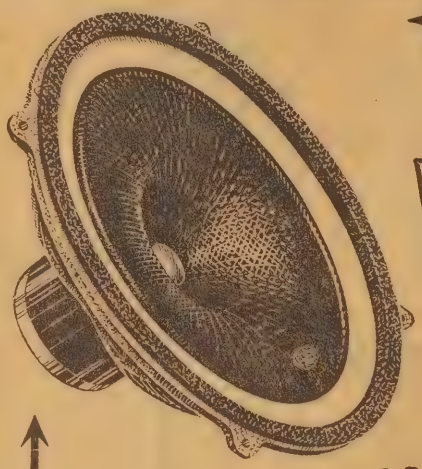

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Suspension: Cloth; Cone Resonance (Exponential Cone): 30 c.p.s.; Frequency Range: 20/13,000 c.p.s.; Flux Density: 15,000 lines per sq. cm.; Max. Peak A.C. Input (Open Baffle): 15 Watts; Voice Coil Diameter: 2".

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Suspension . . . Cloth
Cone Resonance (Exponential Cone) . . . app. 35 c.p.s.
Frequency Range . . . 20/17.000 c.p.s.
Flux Density . . . 15.000 lines per sq. cm.
Max. Peak A.C. Input (Open Baffle) . . . 15 Watts.
Voice Coil Diameter . . . 1½".

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Telephone: **Cent. 2813.** *N.B.: From the end of November:* **MF8211.** *(2 Lines)*

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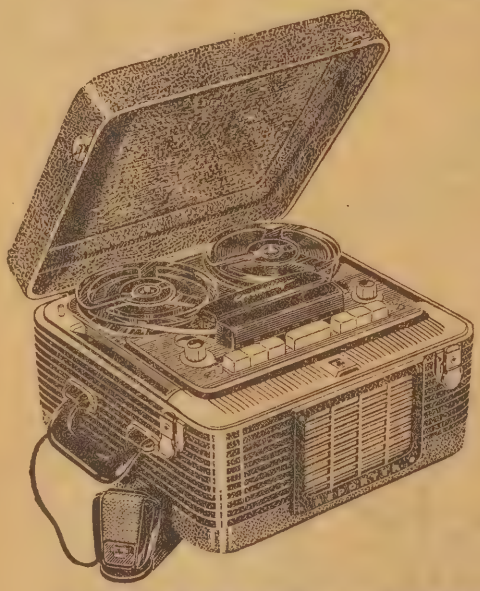

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BIAS FOR MAGNETIC RECORDING

The whole success of magnetic recording is dependent on the use of a suitable magnetic "bias". Some important points about the choice of bias are outlined in this article, contributed by an engineer of the Minnesota Mining and Manufacturing Company (Aust.).

THE history of bias goes back nearly 50 years to 1907, when Poulson and Pederson discovered and patented DC biasing for magnetic recording. It involved superimposing the magnetising force produced by the signal on to a constant magnetising force produced by a permanent magnet or by passing DC through a coil.

The mechanism of AC (or high frequency) biasing, patented in 1927 by Carlson and Carpenter, effected a further basic improvement in the quality of magnetic recordings and is used today almost universally.

Recordings made with AC bias have only a fraction of the background noise of DC bias recordings, hence its widespread adoption.

The puzzling question is, of course, why any form of bias at all should be necessary.

It stems from the fact that every magnetic medium is essentially non-linear. The solid curve in Fig. 1 demonstrates this characteristic. It shows that the magnetisation resulting from a given magnetising field is not directly proportional to the field.

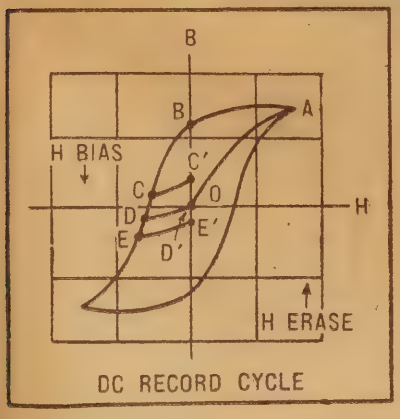


Figure 2: This diagram in association with the text, illustrates the function of DC bias.

If we attempt to record a sinoidal applied signal (magnetising force) without any auxiliary assistance, it leaves a distorted remanent-induction wave pattern in the recording medium.

The unsatisfactory nature of a recording resulting from such non-linear distortion can be shown to be caused by odd harmonics and by intermodulation of two different frequencies, with sum and difference frequencies produced by this intermodulation process.

Magnetic recording would be very limited in its use it if had not been for the discovery of the two biasing methods available for straightening

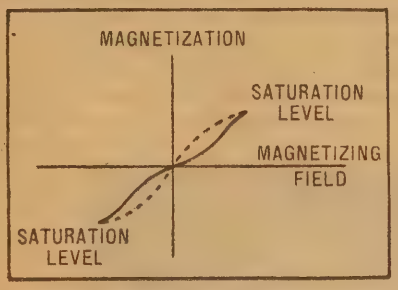


Figure 1: Natural magnetic transfer curve (solid line) is non-linear, hence the need for some biasing method.

out the transfer characteristic.

It is of interest to examine briefly the process of recording with DC bias, in view of its historical significance and, as will be seen, because of the critical nature of the optimum bias requirement.

Recording with DC bias gives a poorer signal-to-noise radio than is obtained with high frequency bias, and so has yeilded to the latter method for nearly all audio applications. However, for low quality audio work, computing machines, i.e., the use of DC bias may have advantages by virtue of its simplicity.

When recording is to be accomplished by means of DC bias, the normal procedure involved is the following: The recording medium is, first of all, magnetically saturated in one direction with a strongly magnetised erase head, as indicated by OAB in Fig. 2.

FUNCTION OF DC BIAS

In the record head, the function of the DC bias is to bring the medium to a point such as D, and, for no signal, on leaving the record head the tape will be in the magnetised state D'.

In the presence of a signal, the tape coming from the state B may reach the points CDE, etc., and hence, have a recorded signal on it correcponding to C'D'E, etc.

It is evident then that although the same erase head field may be used to saturate any tape (providing only that the field is sufficient to saturate the most difficult one), each magnetic tape that has a different B-H curve is apt to have a different DC bias requirement.

It turns out in practice that, not only are different biases required, but that the required biases are critical to within a few percent.

This means that a machine employing DC bias which was set to record on a tape with a high coercive force would not record at all satisfactorily on a tape with a low coercive force, without changing the bias.

It thus differs from AC bias recording where, although the optimum biases required are different, various media can be recorded fairly satisfactorily at the same bias.

The reason that the bias is so critical is that, as one shifts to a bias that is either too high or too low, there appears a marker increase in second harmonic distortion.

Since the presence of undue second harmonic is indicative of improper bias, the correct bias may be found quite simply by putting in a large audio signal and adjusting the bias until the second harmonic contribution is a minimum. This condition actually corresponds to the condition for maximum response.

The bias as determined in this way is critical enough to allow one to distinguish between various kinds of magnetic coatings. Typical curves of output and second harmonic distortion versus bias current for a constant input are illustrated in Figure 3.

ADVANTAGES

The above discussion brings to mind some advantages which AC bias has provided for magnetic recording: (1) better signal-to-noise ratio, to a large extent due to the quieter erase, (2) less critical bias requirements, and (3) along with the increased signal in a good system there appears none of the second harmonic distortion which is so prominent in recording with DC bias.

Because of these factors it is now almost universal practice to use AC (or high frequency) "bias". This is a high frequency (above the audible range, usually 30 to 80 Kc/sec) current added to the audio current which is to be recorded.

When this is done, the recorded audio magnetisation may then be nearly linear to the audio signal as shown by the dotted line of Figure

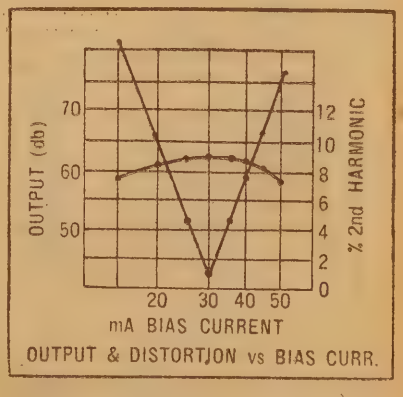
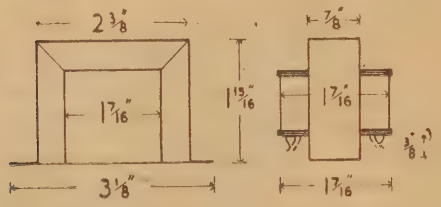


Figure 3: A plot of output and 2nd. harmonic distortion against DC bias current. Note how critical the bias is.

R.C.S. release details of . . . CHOKES . . . TRANSFORMERS

Here are full details of types available in R.C.S. filter chokes, audio chokes and transformers, filament and auto transformers, speaker transformers and speaker replacement windings. It is suggested that these details be kept for reference. These R.C.S. components are both designed and manufactured in the light of latest findings in the field of electronics. Brackets are of aluminium and bobbins are of moulded polystyrene.

FILTER CHOKES AND SPEAKER TRANSFORMERS
Size: Core Section ¾in x ¾in 10 watts
o/all sizes 2½in L x 2in H x 1½in W



FILTER CHOKES

	Retail Price
TC 66 14/60	10/6
TC 66 Windings only	6/6

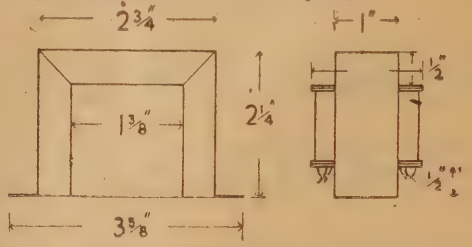
SPEAKER TRANSFORMERS

Type	Primary Ohm	Voice Coil Ohm	
TS 23 Single Triode	3500	2.3	16/-
TS 24 Single Triode	3500	3.9	16/-
TS 25 P/P Triode	3500	2.3	16/-
TS 26 P/P Triode	3500	3.9	16/-
TS 27 Single Pentode	5000	2.3	16/-
TS 28 Single Pentode	5000	3.9	16/-
TS 29 P/P Pentode	5000	2.3	16/-
TS 30 P/P Pentode	5000	3.9	16/-

SPEAKER REPLACEMENT WINDINGS

F 132 Single Triode	3500	2.3	7/-
F 133 Single Triode	3500	3.9	7/-
F 134 P/P Triode	3500	2.3	7/-
F 135 P/P Triode	3500	3.9	7/-
F 136 Single Pentode	5000	2.3	7/-
F 137 Single Pentode	5000	3.9	7/-
F 138 P/P Pentode	5000	2.3	7/-
F 139 P/P Pentode	5000	3.9	7/-

CHOKES AND TRANSFORMERS
Size: Core Section 7/8in x 7/8in 15 watts
o/all sizes 2¾in L x 2in H x 1⅜in W



FILTER CHOKES

	Retail Price
TC 60 100 M/A 30 H	17/8
TC 70 75 M/A 50 H	18/-
TC 65 50 M/A 30 H	16/4
TC 58 L/T 3 amp 50 M/H Vib.	17/6

AUDIO TRANSFORMERS

TB 42 A Class 3 to 1	27/-
TB 43 A Class p/p 3 to 1	28/-
TB 44 B Class p/p 1½ to 1	27/-

AUDIO CHOKES

TA 4 100 H 1000 ohms	21/-

FILAMENT AND AUTO TRANSFORMERS

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TP 54 4.0 v 3 amp	23/-
TP 55 6.3 v 3 amp 15 watt	20/6
TP 80 6.3 v 4 v and 2.5 auto	18/-
TP 56 12.0 v 1.5 amp	23/-
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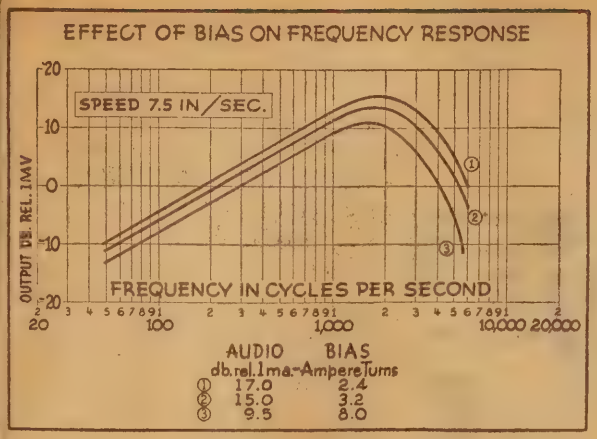


Figure 4: The relationship of bias and frequency response, assuming a given recording head, tape and tape speed. Note that too much bias (curve 3) hastens the roll-off at the top of the range.

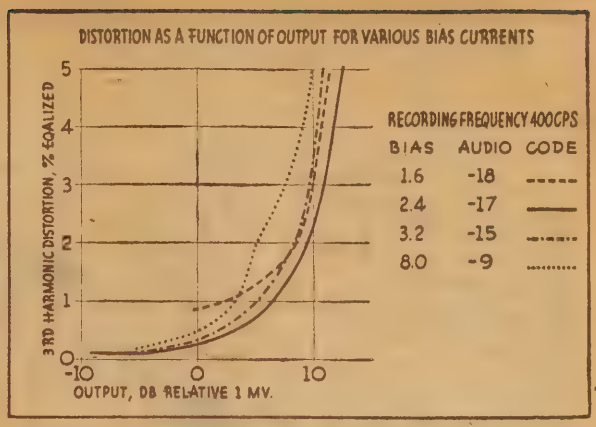


Figure 5. The relationship of distortion to recording bias. Note that bias currents higher or lower than optimum (solid line) result in greater distortion, particularly at higher outputs.

1. By the use of this bias current the output for weak signals is very greatly increased, and distortion of all but saturating signals is decreased to a very acceptable value.

So far as distortion is concerned, the frequency of the bias current is not critical, but it should be at least five times the frequency of the highest audio signal to be recorded. This is primarily to prevent the appearance of unwanted notes arising from beats between the bias frequency and harmonics of the audio frequency.

The amount of bias current is best chosen by tests of distortion at various frequencies and recording levels, including measurements, like those shown in the curves describing tape characteristics.

Different magnetic tapes in general operate best at different values of the AC bias current. Too low a value of bias may result in high distortion and low signal-to-noise ratio. A bias current set at too high a value results in loss of response at high frequencies.

Except in machines designed for professional use, the bias setting is normally pre-set. For purposes of test, however, an approximation of the optimum value of bias may be had through the use of an audio oscillator, a vacuum tube voltmeter, and some means for measuring output of the playback system.

ORDINARY METER

Connect the VT voltmeter across the bias winding of the recording head where its reading will be proportional to the bias current. Record a 1000-cycle note at some level well below the overload point of the tape. Observe the output of the playback system at different values of bias current, keeping the recording level fixed.

If no VT voltmeter is available, a high resistance AC voltmeter may be used, but it must be remembered that an RF voltage is being measured, and, because of this, inductance and capacitance of components, rectifiers and wiring will affect the measurement.

Thus the reading on such a meter would be used only to indicate that some change in bias has been accomplished but the meter reading has no absolute value. As long as the same measuring system is used each time in the same manner, this substitute for a VT voltmeter is permissible.

For some value of the bias a maximum output will be observed. The following rules will help select the operating bias in terms of the bias current for maximum output.

For Low-Speed Machines Using DC Erase: To obtain the best signal-to-noise ratio it is necessary to compromise by sacrificing high frequency response. The optimum bias current is approximately 50 pc greater than the bias for maximum output.

For Low-Speed Machines Using High Frequency Erase: Because a good AC erase system results in a lower tape noise level than DC (or permanent magnet) erase, a lower value of bias may be used. Adjust the bias for maximum output of the 1000-cycle signal.

BUILT-IN METERING

For High - Speed Professional Machines: In general, more precise techniques for bias setting are required for professional machines. A reasonable compromise, however, is to choose a bias current twice that for maximum output of the 1000 cycle signal.

Professional machines usually have a built-in V.T. voltmeter for measuring the bias voltage and a separate playback head so that the output can be monitored immediately after recording. The effect of a change of bias can be read directly on two level meters, one on the input to the record head and the other on the output of the playback head.

Figure 4 shows the effect of the bias on frequency response. These curves were obtained with a constant audio recording current and with a bias frequency of 40 kilocycles per second. (The actual number bias ampere turns, is of course, dependent upon the particular recording head used, but the effect of changes will be substantially the same for various types of head.)

It may be seen that, in general, the higher the bias current used, the poorer the high frequency response relative to the low frequency response.

In point of fact, however, the bias should not normally be chosen to adjust the frequency response. The primary function of the bias current is rather to minimise distortion. For this purpose, the correct bias current is chosen by taking data similar to that shown in Figure 5.

Figure 5 shows distortion (as the third harmonic distortion at a re-

(Continued on Page 108)

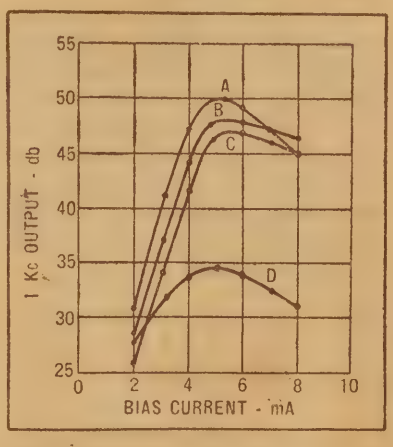


Figure 6: The relationship of playback output to AC bias current for various tapes, old and new.

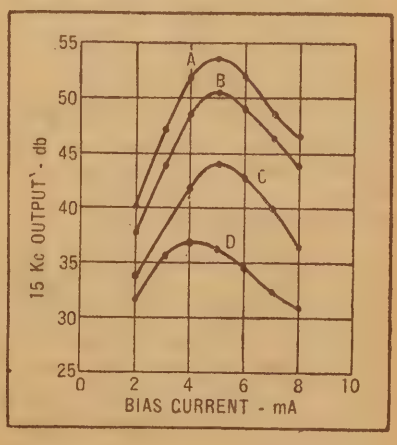
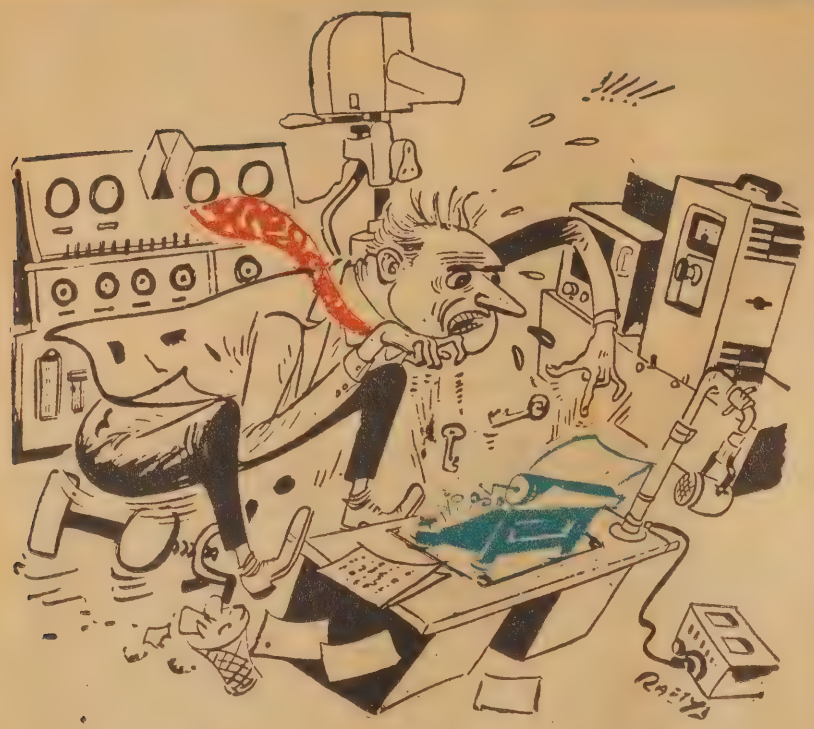


Figure 7: Similar curves to figure 6, but at test frequency of 15Kc. Note that tape C is down.



Let's Buy An Argument

It is often claimed that "Old soldiers never die, they simply fade away". In the realm of radio theory, certain half-truths and misconceptions enjoy even greater longevity, if one is to judge by the contents of some of the "query service" letters.

FOR example, a reader from Western Australia recently asked advice about the construction of a crystal set.

He explained that he had a musical friend, a European migrant, who insisted that the only type of reproduction worthwhile was by means of headphones. That loudspeakers were vulgar devices, operated at much too high a level by the average Australian and incapable, anyway, of producing really good results.

Over in Germany, one could do very well with headphones, a crystal set and not a very big aerial either!

INTERNATIONAL RIVALRY

Without trying to prejudice international relations, I must say that some of the recent stories about what can be done in Germany seriously rival reports of what they can do in the United States!

I have yet to discover why a crystal set on German soil is any less bound by distance and field strength than one on the local scene. However, enough of that.

Let's talk about headphones for a start.

On the credit side, it must be said that they lend a degree of intimacy and concentration which a loudspeaker cannot easily match. One is "shut in" with the signal, isolated from all the petty distractions of the normal household.

It's little wonder if the program seems more enjoyable as a result.

Then, again, with tightly fitting phones, there is a very intimate degree of coupling between the diaphragm and the mechanism of the ear. Low and high frequencies alike can be heard, without the need for baffles and horns.

The resonance problems which may result therefrom are eliminated at one stroke, there are no standing waves, no room echoes, no problems of amplifier overload.

by Neville Williams

All these things are very good, but . . .!

I wonder if our migrant friend, and those who repeat like sentiments, have ever stopped to think that earphones are in no sense exempt from ordinary electro-acoustic laws. That the vast majority of earphones in existence—and that most folk have ever heard—are very primitive in their design.

They use a stout metal diaphragm that simply must have an equally stout resonance. They show wide frequency variations elsewhere in the range. They use an unbalanced motional system that must be a prolific source of non-linearity. They do not fit the ears closely enough to prevent pressure loss at low frequencies.

PURE TONE?

How reproduction through such devices could ever be identified with "purity of tone" is beyond me, but the fact remains that it is—and very frequently!

It's only one step better than raving about the quality from Grandpa's "Table Talker", which used the same kind of motional system.

Better quality earphones have been made, of course. For a spot of private listening, I often use a pair of dynamic units with earmuffs. They're not bad, provided they clamp tightly to the head.

Even better were a pair of imported crystal phones I once used, but now defunct because of faulty crystals.

And I've heard people tell of excellent results from certain deaf-aid type phones, with attachments which plug right into the ear canal.

With phones of this order, reflecting something of the modern approach, one might be able to talk about quality of reproduction.

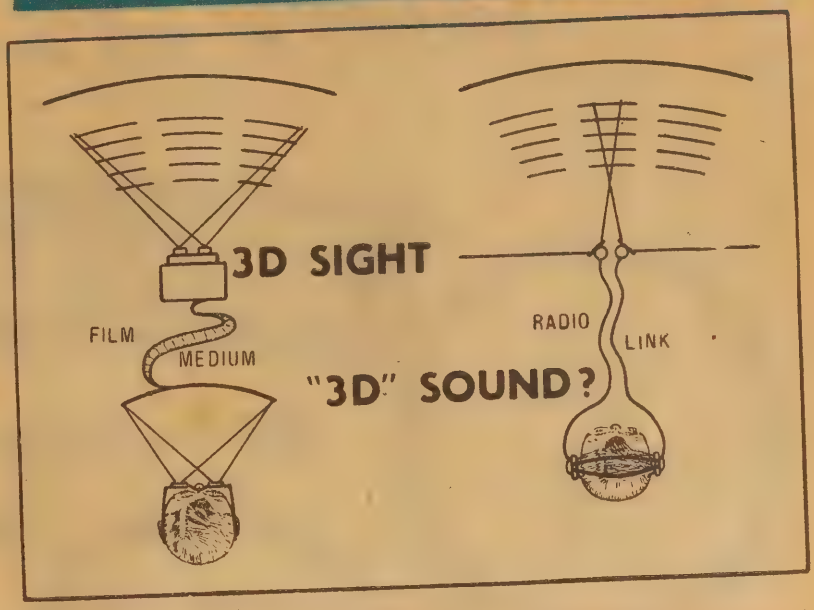
Otherwise it's just a matter of what you prefer: (1) Intimate, low-level listening, peaks, &c., notwithstanding or (2) Higher level from a more elaborate reproducer, punctuated by wasing-up noises from the kitchen.

THE ALTERNATIVES

Much the same remarks apply, of course, to enthusiasts who speak in such glowing terms of crystal sets and their unique "purity of tone".

It would be much nearer the mark to say "clarity of tone", stemming from a combination of phone characteristics and listening level which

NEW APPLICATION FOR PHONES?



It is often stated that earphones, separately fed, are as essential for spacial sound as spectacles appear to be for 3D viewing. Only by such means can the separate stimuli be preserved for each ear or eye. True or false?

llows only the middle register to e heard to advantage.

But that's just the reverse of high delity requirements, which demand hat all frequencies be amplified and eproduced without discrimination.

It is most enlightening to amplify he output from an ordinary earhone with the aid of a good quality nicrophone and amplifier.

And it's enlightening, too, to mplify the output from crystal deectors. Most of the new crystal liodes are very good but I've heard trocious distortion from some of the lder varieties of detectors.

You see, even "crystal" detectors ave linearity curves which exhibit sharp or rounded "knees", good and oad regions, minimum signal requirements and so on.

Just in passing, it is interesting to note that the earphone v. speaker controversy is liable to flare up whenever talk gets round to twinchannel listening. I say twin-channel in an effort to avoid confusion between the terms "binaural" and "stereophonic".

USUAL IDEA

The usual conception of twinchannel listening involves the use of two speaker systems spaced slightly apart and fed respectively with signals picked up from either side of the sound source.

Many contend that it is not possible by this method to achieve effective twin channel listening because it involves the compromise step of recreating the sound in breadth before the ears can begin to "locate" its apparent source (or sources).

Using separately excited earphones, however, and two microphones arranged to imitate the position of ears on the human head, the subject is virtually transported to the microphone position, without any artificial acoustic process intervening.

To enjoy twin-channel listening without earphones, they say, is as impractical as 3D viewing without spectacles.

I can only hope for their sakes, that the public takes more kindly to earphones than it did to spectacles.

A vain hope I fear!

GREAT AERIAL MYSTERY

Another familiar "mystery" was resurrected in a letter from a Queensland reader, E.W.

He was mystified to find that his radio brought in more stations and louder signals with the aerial and earth connections reversed. How could this possibly be?

I seem to remember talking about this very point on a previous occasion but a brief repetition of the facts should not be out of place.

As a general rule—and almost certainly in this case—the key to the riddle is found in the power mains supplying the set.

Wandering across the landscape, the mains act as quite efficient aerials and pick up a lot of radio signals. Normally, the radio signals should get no farther than the primary winding of the power transformer, their progress beyond this being blocked by the electrostatic shield around the primary, which is connected to chassis and thence to earth.

This leaves the normal aerial to pick up the required radio signals and pass them through the aerial primary winding to earth, coupling to the first tuned circuit as they go.

If the aerial and earth are both good, the signal pickup will also be good and all will be well.

However, disconnecting the direct earth wire from the chassis may completely alter the picture for better or worse.

It may simply reduce the efficiency of the earth return and reduce signal strength as a result. (That is why a battery set generally requires a good earth.)

On the other hand, it may allow some of the radio signals in the mains wiring to reach the input circuit, instead of being shunted straight to earth. This may conceivably produce an increase in signal strength, particularly if the aerial is not a very efficient one.

Herein lies the usual answer to mystery number one—why the signals from a mains-operated set are often stronger when no earth wire is used. Or, yet again, why there is a possible difference between a direct earth return and one made via the power socket.

EARTH-WIRE "AERIALS"

It is just one step further to reverse the aerial and earth connections, thus having the set's aerial terminal connected to earth.

When this happens, signals from the mains may couple capacitively to the receiver chassis, via the power transformer. The chassis thus becomes "alive" for radio signals, which pass through the primary of the aerial coil to the aerial terminal and thence to earth.

The aerial proper becomes largely redundant and it often matters little whether it is connected to the receiver earth terminal or not.

And herein lies the usual answer to problem number 2 . . . how an earth wire is seemingly a better "aerial" than the aerial itself.

It isn't! It's merely connected to the set in such a way that it reverses the polarity of the primary winding, allowing the mains to act as an aerial.

Unless I miss my guess, the same circumstances govern the operation of various gadgets which supposedly replace the aerial, being connected between the set's aerial terminal and earth

The second question raised by our correspondent follows very logically on his first:

Since the signals are louder with the aerial and earth reversed, is there any objection to using the set this way?

As we inferred earlier, lots of other readers have made the same observation from time to time and asked the same question.

A CATCH TO IT

In general, there is no real objection to using the set with connections reversed, provided the results are indeed better.

But "better" means something more than just "louder".

The big difficulty about signals arriving via the mains is that they are likely to be mixed up with electrical interference. Noise from appliances, poor contacts, switching operations and all the rest may be fed into the receiver and amplified along with the radio signals.

It's a poor consolation if, to get twice as much signal, we have to put up with three times as much noise.

And it's poor consolation, too, if the strength of signal jumps every time someone operates certain

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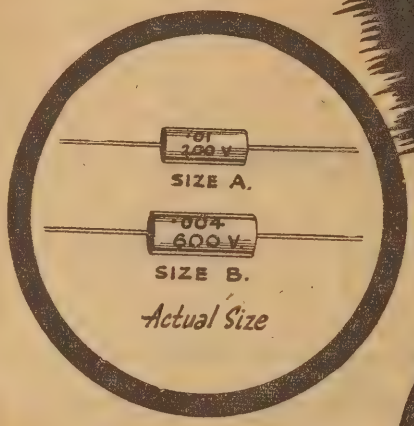

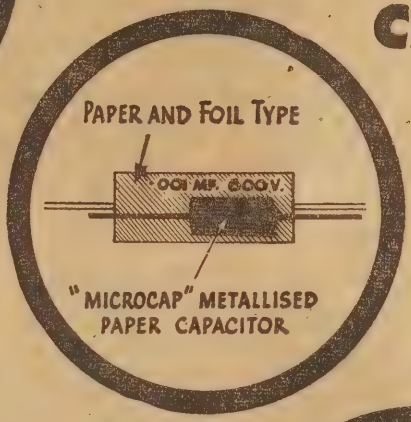

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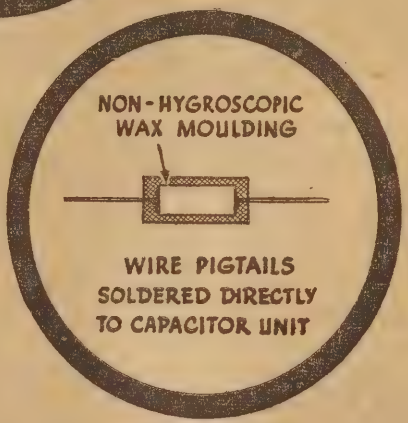

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200 Volts D.C. Wkg.		**600 Volts D.C. Wkg.**	
.004 uF	A	50 pF	A
.005 "	A	100 "	A
.01 "	A	200 "	A
.02 "	B	250 "	A
.03 "	B	300 "	A
.04 "	B	500 "	A
400 Volts D.C. Wkg.		.001 uF	A
.001 uF	A	.002 "	B
.002 "	A	.003 "	B
.003 "	A	.004 "	B
.005 "	B		
.01 "	B		

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witches around the house, thereby ncreasing or decreasing the amount f signal pickup.

If none of these nasty things hap-en, there's no serious objection to orgetting the earth wire, reversing he aerial and earth connections or sing a patent gadget.

But don't forget the implication. f any of these measures result in greater signal strength than using our aerial in the normal way, then perhaps your aerial is a long way below par.

Maybe a longer wire and a higher pole will give you even better results.

VALVE FILAMENTS

Changing the subject yet again, we have had two or three letters recently from readers with "bright" ideas about valve filament connections. The queries differed in form, but all stemmed from the same misunderstanding of certain fundamentals.

Perhaps this might be the best place to start.

Have a look at figure 1, which shows a typical battery triode, with the negative side of the filament grounded, the positive side fed from a 1.5 volt cell and the grid circuit returned ultimately to earth.

Question: What is the effective bias on the grid?

Answer: Zero.

Retort: Wrong!

Protest: But the book says . . . .

Yes, I know, we could, at this stage, became embroiled in an argument about terminology, but I don't want to do that. I want rather to explain why I should contradict what looks like a simple answer to a simple question.

Getting down to brass tracks (proverbial variety), the effective bias for a valve might be defined as the initial potential difference existing between its control grid and the emitting surface of the cathode.

With an indirectly heated cathode, there is little room for ambiguity, because the cathode is a single metal sleeve of uniform potential. Perhaps that's why the valve manufacturers refer to it as a "coated uni-potential cathode"!

Just the reverse is true in the case of a directly heated filament because the potential along its length varies by a figure equal to the applied filament voltage. Besides being a statement of the obvious, this is a very important point.

ZERO BIAS

In figure 1, for example, one end of the filament is shown as being connected directly to earth. If the grid input circuit also returns to earth, it can truthfully be said that there is no bias between these two points.

But what about the other end of the filament?

This is 1.5 volts positive with respect to earth, and, therefore, to grid. In other words, as far as this end of the filament is concerned, the grid has a bias of minus 1.5 volts.

Had the grid been returned to a 3-volt bias battery instead of direct to earth, the actual bias would vary from minus 3.0 at one end of the filament to minus 4.5 at the other.

There is, therefore, ample justification for suggesting that the effective bias on a battery valve is a mean or average figure equal to the potential difference between the grid and the centre of the filament wire.

In the case of figure 1, this would be equal to a bias of minus 0.75 volt. Hence our unconventional retort to the question earlier.

However, be this as it may, it would be awkward to relate all ratings to this inaccessible mid-point. One would forever be working out little sums involving half the applied filament voltage.

To avoid this, manufacturers have adopted the convention of relating all battery valve ratings to the negative end of the filament.

But which end of the filament is negative?

For most valves, one could simply answer "either" and be perfectly correct.

However, once again, valve manufacturers have resorted to a convention and religiously code the filament connections "plus" and "minus." In general, it is logical and convenient to observe this practice when wiring a receiver.

In fact, in some cases it is important to do so. Diode-amplifier valves, for example, have tiny diode plates adjacent to particular ends of the filament.

NO DELAY VOLTAGE

If a diode return circuit is earthed and likewise the end of the filament adjacent to it, then the diode will operate without a delay voltage. That's the way it must be for a diode detector.

If the filament connections are transposed, however, and the diode return left to earth, the diode will find itself with a delay equal to the applied filament voltage. Such a delay would be tragic for a detector but very handy for an AVC circuit.

For this very reason, some diode-amplifier valves have been made with the diodes placed, one at each end of the filament. One is intended for detection, the other for AVC.

In other comparable valves the diodes have been placed side by side at one end of the filament. Still other valves have only a single diode at one end of the filament, generally "filament minus".

Unless due care is taken with connections and circuitry, unsatisfactory operation will obviously result.

However this is rather a specialised case which concerns, at the most, only one valve in receiver. On a simpler plane, we can proceed to discuss some of the ideas we referred to at the outset.

REVERSED CONNECTIONS

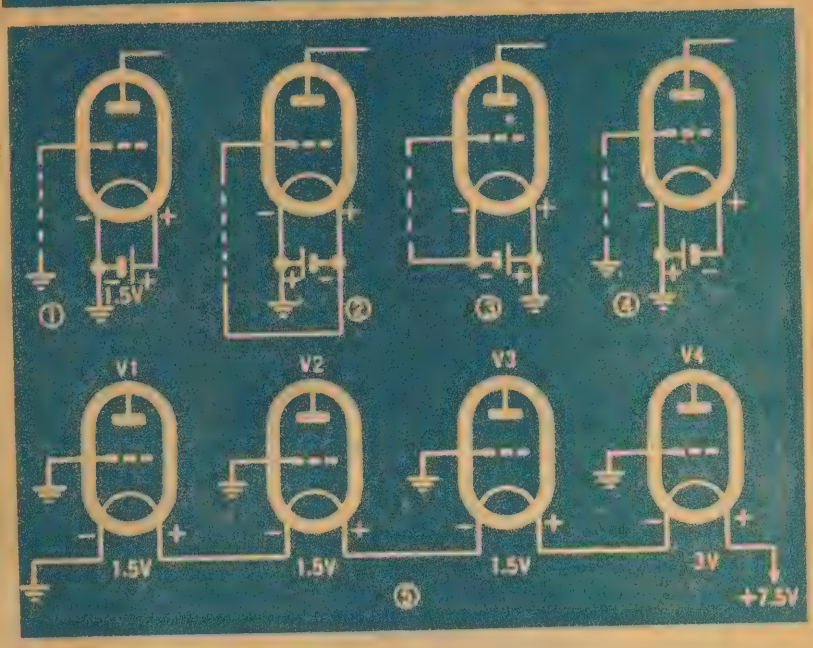
Someone wanted to know, for example, whether it would not be possible to utilise the filament voltage as a source of bias by reversing the connections to the filament battery and transferring the grid return to the negative terminal.

The circuit would be equivalent to figure 2. On the surface, the grid now looks to have a bias of -1.5 volts but let's examine it on the basis of actual potential between grid and filament.

Despite all the plus and minus signs, it becomes immediately evident that the grid is still returned to one end of the filament, so that no bias can exist between these two points.

The other end of the filament is positive with respect to grid by 1.5 volts, which is the same thing as saying that the grid has an effective bias at this point of minus 1.5 volts. The mean of these two extremes is obviously a bias of -0.75 volts, which is the same as for figure 1.

FACTS ABOUT FILAMENT CIRCUITS



Filament circuits appear to be such simple things but they still provide plenty of scope for confusion.

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In short, the only effect of our manipulation has been to make the circuit unconventional.

You get exactly the same answer by wiring the filament in the conventional fashion but earthing the positive side, as in figure 3, and returning grid to filament minus.

But what happens in a receiver if one merely reverses the external connections to the "A" battery, without interfering in any way with the internal wiring.

This "experiment" is often performed by would-be enthusiasts who observe that it sometimes "improves the volume".

If we re-draw figure 1 to effect this change, leaving the grid circuit undisturbed, we get figure 4. On the surface the valve still appears to have zero grid bias but let's check it more closely.

There is certainly zero bias between grid and the grounded end of the filament. But what of the other end?

THE OTHER END

This now negative with respect to grid by 1.5 volts, which means that the grid has a 1.5-volt positive bias at this point in the electrode structure. The average or mean bias is now plus 0.75 volt, as compared with minus 0.75 volt for figure 1.

In other words, our "experiment" has shifted the bias in a positive direction by an amount equal to the filament supply.

The immediate effect of this must be to change the operating condition of the valve and, most important, make it draw more plate current. It will have this effect, irrespective of whether the valve is a zero-bias type or supplied with additional bias from an external source.

In a little one-valve set, the variation in operating conditions and plate current would probably not matter at all, the normal reaction being to use it the way it works best. That's why grid leaks are often run back to filament plus, achieving much the same as reversing the A-battery leads.

But it doesn't follow that the same procedure is permissible with all battery sets.

One can easily see how an all-round reduction in bias for a multi-valve set could push up the battery drain by quite a serious amount. You see, volume isn't the only criterion of design—not in a battery set, anyway!

REVERSED BATTERY

But if the increase in battery drain is "quite serious" with the filaments connected in parallel, just imagine the effect of reversing the A-battery connections to a series network, such as in figure 5.

If the filaments were connected in this simple fashion (neglecting shunts, &c.), and each grid returned ultimately to earth, V1 would have zero grid bias, V2 would have —1.5 volts, V3 would have —3.0 volts and V4 —4.5 volts. This represents, in each case, the potential difference between grid and the negative filament pin.

Reversing the filament connections would change all the bias signs to positive. The mean bias on V4, referred to the centre of the filament,

(Continued on Page 109)

FOREMOST IN SOUND

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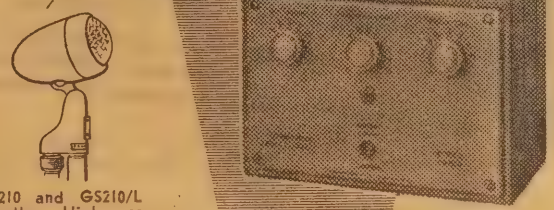

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This equipment consists of five units—Power Supply, Power Amplifier, Equaliser-Preamplifier, Low Pass Filter and wide range tuner.

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TECHNICAL SUMMARY.

Output frequency response of complete system from input to output — 20 cps. — 15,000 cps. + or — 1 lb.
Harmonic and intermodulation distortion — Negligible.
Maximum rated power output — 12 watts.
Hum and noise level — 60 db below full output.
Alternative input terminals are provided for magnetic or crystal pick-ups.

Degree of treble boost at 10KC/S relative to 1KC - 19 db.
Degree of treble cut at 10KC/S relative to 1KC - 19 db.
Degree of bass boost at 50 cps. relative to 1KC - 19 db.

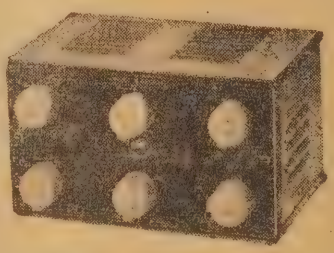
} Continuously variable

HIGH FIDELITY RADIO TUNER *(illustrated)*

Has frequency coverage of 530 to 1,620 KC/S. Incorporates a 10Kc/s whistle filter and special low distortion detector circuit. Large perspex dial calibrated for all Australian States and in metres and kilocycles.

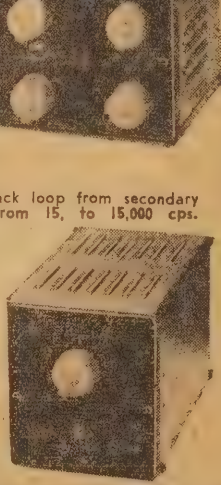
EQUALISER-PRE-AMPLIFIER UNIT *(illustrated)*

Extremely wide flexibility of control is afforded over the entire musical spectrum, providing innumerable combinations of tonal balance. Six controls are utilised viz., a 5 position record equalising switch for all makes of records, a radio-records switch, a treble rise—treble fall switch, a volume control, a treble control, and a bass boost control (both continuously variable).



POWER AMPLIFIER UNIT Incorporates highest quality output transformer with 17 db inverse feed-back loop from secondary to amplifier input. Stable, low noise, straight forward amplifier with a completely flat frequency response from 15, to 15,000 cps. Negligible harmonic and intermodulation distortion.

LOW PASS FILTER UNIT *(illustrated at right)* A "top cut" filter for eliminating intermodulation distortion and/or surface hiss from worn or poor quality recordings when played either at home or broadcast on the radio programmes. Designed to provide a sharp cut-off characteristic at 2 cut-off frequencies viz., 6 KC/S and 8 KC/S plus a third position in which the filter is switched out of circuit to utilise the full range linear frequency response characteristic of the amplifier.



POWER SUPPLY UNIT Comprises a centralised power supply for the Ferris Hi-Fi Home Music System (or any other suitable equipment) and provided with sockets for plug-in cable attachment to the other units. A 6 volt A.C. outlet is also provided for external panel illumination, etc.

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EQUALISER-PREAMPLIFIER ..	£20 11 0	LOW PASS FILTER UNIT ..	£12 8 6
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GETTING YOUR AMATEUR LICENCE

In this month's article we consider what happens when the output stage of a transmitter is plate modulated. This is the only method of amplitude modulation which has achieved any great popularity among amateurs, although there are other methods of amplitude modulation which could be used.

NOT all transmitters are simple oscillator – amplifier affairs. Sometimes we need extra amplification between the oscillator and output stage.

Perhaps the oscillator hasn't enough driving power. Perhaps we merely want isolation of the oscillator to make it completely independent of inter-action with the output or final amplifier so that its frequency stability may be improved—quite good practice where the oscillator is self-excited as in a VFO.

In such cases we insert a buffer amplifier between the oscillator and the output stage, or maybe more than one. A buffer can also be used as a frequency multiplier.

BUFFER AMPLIFIERS

A buffer amplifier is similar to a final amplifier in that it is usually run under class C conditions. If a triode, with its grid and plate circuits at the same frequency, it will need to be neutralised to prevent self-oscillation. Pentodes and beam power valves do not always require neutralising, although it is a good plan at high frequencies for highest stability

But there are certain differences between a buffer and a final amplifier. The buffer need not produce more power than is required to drive the final grid circuit. As it is never modulated, its tank circuit L/C ratio can be selected to give a high driving voltage for the next stage, which generally means high L and low C.

In a final amplifier, the L/C ratio must be selected to give an optimum figure of Q to ensure among other things a low percentage of harmonic radiation from the tank circuit into the aerial. This calls for a lower L and higher C than for a buffer amplifier. A ratio is generally selected which will provide a circuit Q of about six for an unmodulated stage, and about 12 for a modulated stage, the actual values being obtainable from tables in published handbooks.

TANK CIRCUIT Q

The buffer stage may have a tank circuit Q of 4 or 5 to quote a general figure, as it is not so important to limit its percentage of harmonics.

When a buffer stage drives a modulated final amplifier, it should be capable of appreciably more output than is nominally required by the grid circuit it drives. The impedance load imposed by this grid circuit varies greatly when the amplifier stage is modulated, and, to preserve reasonable regulation, the buffer should not be loaded to the limit. It must also make up circuit losses, which are always present, not only in the components used, but in the methods of coupling which must be employed.

Buffer stages are frequently used to give output at some multiple of the frequency at which their grid circuits are driven. In such cases we call them frequency multipliers. Most valves properly used will give quite high comparative output as frequency doublers, and many will work well as triplers or even quadruplers.

Higher orders of multiplication are not often used in transmitters unless for special designs where low efficiency is not a disadvantage

By way of definition, we could say that a frequency multiplier is a valve whose output circuit is tuned a frequency higher than that of its input circuit, and harmonically related to it.

Points to remember about a frequency multiplier:

1. Its efficiency and output are invariably lower than when the valve is used as an amplifier. This is so, because the output tank circuit in which the multiplied oscillations are sustained does not receive power from the valve on each cycle. As a doubler, the tank circuit receives a "kick" every second cycle, as a tripler every third cycle and so on. The "flywheel" effect of the output tank circuit is relied upon to sustain oscillations between each energising pulse or kick from the plate of the valve. The higher the order of multiplication, the lower the efficiency of the valve.

2. To ensure highest efficiency as a doubler, the grid of the valve is biased to several times cut-off voltage, and driven as hard as possible from the preceding stage. This means high distortion of the input wave-form, which is in the form of steep-sided pulses driving the grid into the positive and cut-off regions high distortion means a high percentage of harmonics available in the plate circuit, which is what we require for frequency multiplication.

3. The plate voltage should be as high as possible without exceeding the plate dissipation of the valve. This will ensure the largest practicable voltage swing is available across the tank coil.

4. The tank circuit should have a high inductance and low capacitance to provide a circuit with a high dynamic impedance and ensure the highest possible voltage development. This is important, as a multiplier is invariably used to supply driving voltage to the following grid circuit.

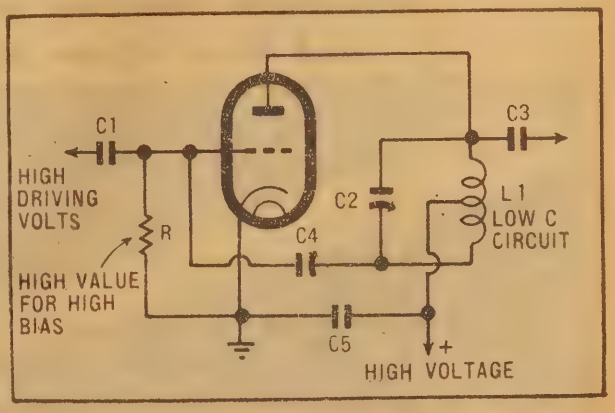

Fig. 1. A typical buffer or multiplier circuit using a triode valve. It is not necessary to neutralise the valve when used as a multiplier, although the neutralising condenser is sometimes employed to give some regeneration which will increase the harmonic output. With suitable screen feed the circuit is suitable for a pentode valve.

Summarising, therefore, a frequency multiplier is designed to have a high harmonic output, whereas a final stage is designed for low harmonic output. Efficiency is generally low, while that of the final amplifier may be quite high. For these and other reasons multipliers are rarely connected directly to aerial circuits.

TYPICAL CIRCUIT

Pentodes and tetrodes make the best multipliers because they give high output with low drive. High-mu triodes also work well. Low-mu triodes are not good multipliers as their drive requirements are apt to be too high.

Fig. 1 is a typical buffer or multiplier circuit using a triode valve. Grid resistor R is high in value to provide high bias from a high driving voltage from C1 which couples to the preceding stage. The tank circuit is C2 and L1, with a high value of L. The neutralising condenser C4 is not needed if the valve operates as a multiplier. C5 is an RF bypass and C3 couples into the grid circuit of the next stage.

The same circuit will suit a pentode valve by adding a bypassed screen connection, and possibly, omitting C4. The high tension could then be connected to the bottom of L1 instead of to the centre.

The foregoing should enable you to answer quite a few general ques-

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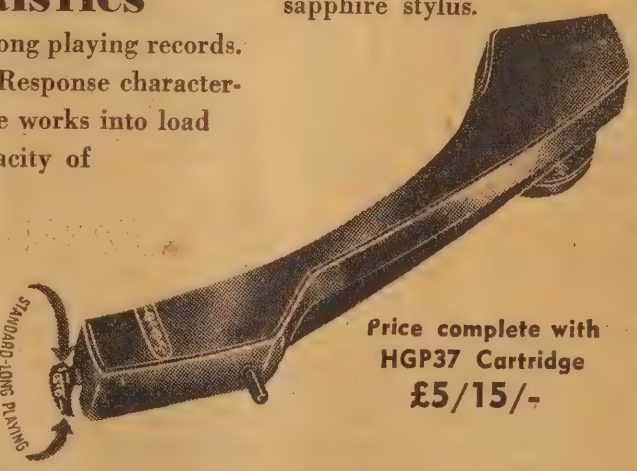

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ons about buffers and frequency ultipliers. We come now to the eration of a modulated Class-C nplifier, which is one thing you ould know very thoroughly.

A full examination of a Class-C nplifier isn't nearly as simple as seems, for it involves many elec- ical quantities balanced one against ie other. It will be sufficient, owever, if you know the import- nt design factors which control iem, and our explanations are iven with this fact in view. Your xt books will carry you much fur- ier if you so desire.

Let us imagine you have been sked to draw the circuit of a late modulated Class-C amplifier, nd to explain how it works.

Such a circuit is shown in Fig. 2. t is simplified, but it is a perfectly ractical circuit. We have shown a eutralised triode in the amplifier ircuit, and a single pentode audio mplifier modulating it. This could vell be found in a low-powered ransmitter.

CLASS-C AMPLIFIER

The amplifier is operated in Class- , which means that it is biased to t least twice the grid voltage need- d to cut off the plate current. The ias is obtained by using a grid esistor R1 in conjunction with RF driving power fed via C1. On the positive peaks of the driving cycle, he RF voltage exceeds the bias, and current flows from grid to cathode. It is the voltage drop across R1 caused by the flow of grid current, which supplies the grid bias. The grid, operating as the anode of a diode, is the negative element.

This simple method of grid bias has the advantage of providing good regulation by automatically adjust- ing the bias voltage according to the amount of drive available.

The resistor value can be work- ed out by Ohm's Law, using the grid current value required for Class-C modulated operation, and the grid bias required by the valve, both ob- tainable from the maker's figures. Sometimes these give the value of grid resistor as well.

The grid current quoted by the makers should never be exceeded, and if the available drive provides a higher value, it may be reduced by increasing the value of R1. With- in reason a higher bias than usual will merely result in higher effi- ciency and lower plate dissipation, provided the RF voltage fed to the grid is itself not greater than the marker's specify for the valve.

GRID CURRENT

Conversely, the grid current should not be appreciably lower than the rated value, otherwise there will be insufficient grid drive for the valve on positive modula- tion peaks, and the output from the amplifier will not be linear. There is in practice a reasonable latitude between these limits.

To ensure there is always enough drive for the valve, the driver should be capable of delivering somewhat more power than requir- ed by the amplifier. You will note by examination of valve specifica- tions that the driving power re- quired for a modulated stage is generally greater than for tele- graphy, because the valve at peaks of full modulation must produce four times as much power, and re- quires more drive to do it success- fully. In actual fact, the grid and plate relationships are somewhat complex, but we need not examine them in more detail here.

There are other methods of ob- taining grid bias. With a grid leak only, bias depends on the presence of RF drive. If this should fail, the amplifier will have no bias, produce no power, and plate cur- rent will rise to a very high value.

To avoid this, enough bias to limit plate current to a safe value is some- times obtained from a battery or power supply, the remainder being obtained by a smaller value of grid leak. Or sufficient bias to protect the valve against failure of drive can be obtained from a cathode re- sistor, bypassed for both RF and audio, in con- junction with a s m a l l e r grid l e a k. In the latter case, the effective p l a t e voltage will be reduced by the amount of pro- t e c t i v e bias needed.

For amateur w o r k, w h e r e failure of drive is not common

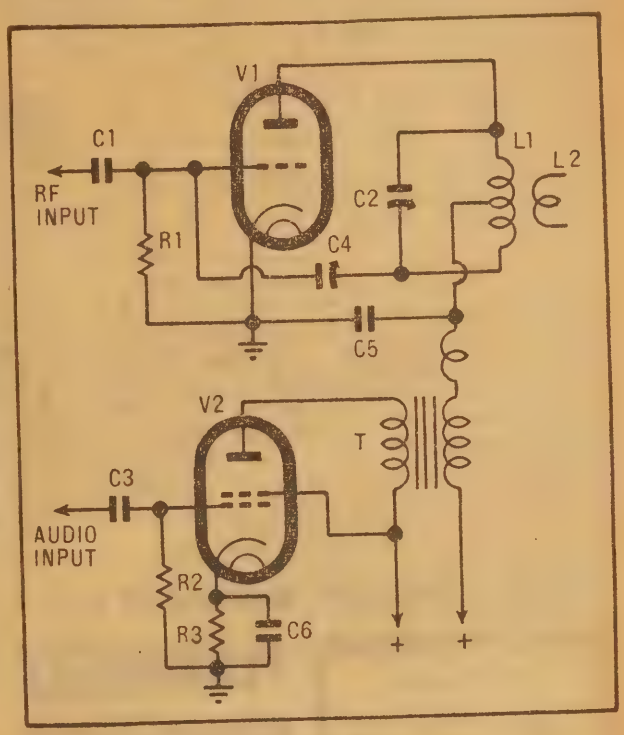

Fig. 2. Circuit of a typical plate modulated stage using transformer modulation. L2 is the aerial coupling coil. L1-C2 are selected to give a generally accepted Q of 12 in this circuit—a Q of 6 is permissible for split stator connection.

with good design and construction, the extremely simple, pure grid bias is generally used, and its self regu- lating feature is valuable in Class-C modulated work.

These are the main points to re- member about the grid circuit of the amplifier, and apply equally to triodes or pentodes. Correct grid circuit conditions are absolutely essential for correct plate modula- tion. Insufficient drive and badly designed grid circuits are a frequent cause of unsatisfactory operation, splatter, and "downward modula- tion". Always examine the valve tables when designing your amplifier stage, and make sure you understand what is needed for the valve you are using.

The output circuit of the amplifier consists of a parallel resonant circuit L1 and C2 which is tuned to the transmitter's operating frequency.

Here are some important points about it:

1. The output from the plate of the valve is made up of a number of sharp pulses which are the result of the "kicks" supplied to the grid. But we require a smooth flow of power from the plate circuit, and this smoothing is accomplished through the "flywheel" effect of the tank circuit. Its ability to store energy is why it is called a "tank".

2. This smoothing out of the dis- torted input is more efficient when the circuit has a high Q. It is par- ticularly important if the amplifier is to be modulated, because any dis- tortion in the RF output wave will also distort the audio signal im- pressed upon it. Therefore a modu- lated stage is generally designed to have a higher Q than permissible if not modulated.

3. The Q of the circuit is adjusted by using suitable ratios of induct- ance and capacitance, which are most conveniently read from charts published in all standard handbooks to avoid tedious calculation. Be- cause the Q of a circuit involves any external impedances connected across it, you will see that the charts give different L/C figures for dif- ferent valve output impedances, ex- pressed in terms of plate voltage divided by plate current. This in- cludes also the impedance reflected from the aerial circuit, the coupling to which will determine the plate current drawn from the valve.

4. A high Q circuit is desirable be- cause it reduces the amount of har- monics which are present in it, and likely to be coupled to the aerial. This reduction is a direct result of the "flywheel" effect which produces smooth sine-wave output from a distorted input. Anything which re- duces the circuit Q will increase the percentage of harmonics. Incident- ally lower circuit Q is permissible with push-pull output stages because of the cancellation of even harmonics which takes place in such a circuit.

OUTPUT CAPACITANCE

5. When considering the amount of C in circuit, the plate-to-cathode capacitance of the valve must be included, together with a small amount representing stray capaci- tances to ground from wiring and components. The latter may not be very important, but the former will often represent an appreciable por- tion of total C.

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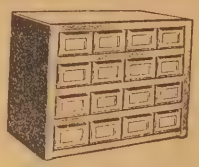

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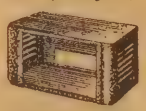

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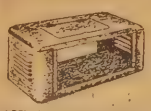

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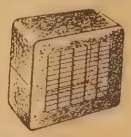

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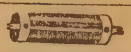

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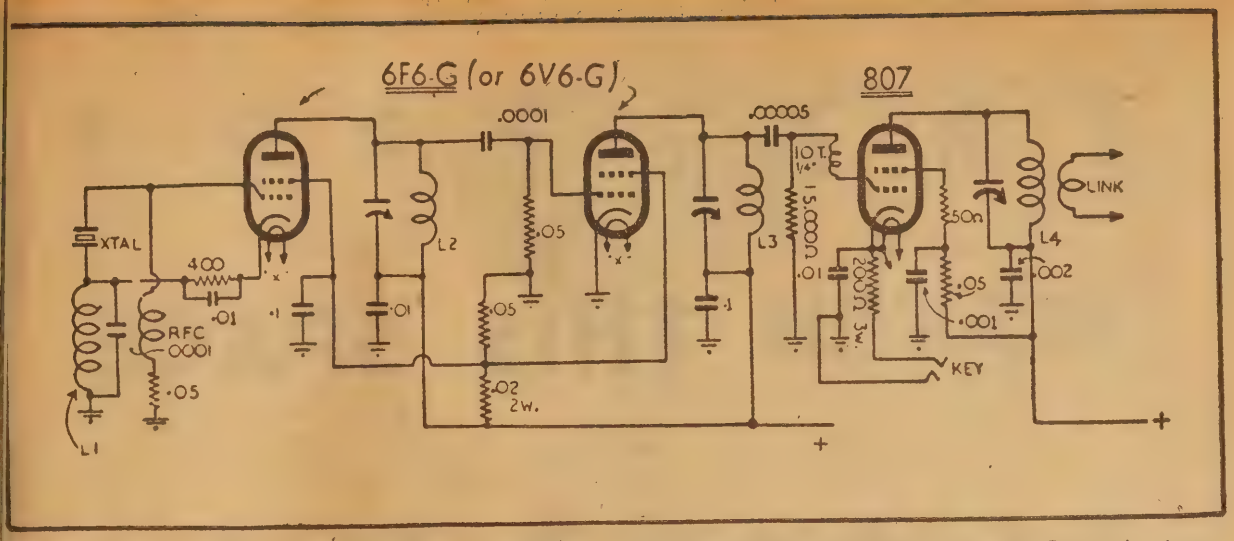

Fig. 3. A practical circuit of a three stage transmitter using a Tritet crystal oscillator, a buffer or doubler stage, and a beam tube output stage. The first two valves can be operated from 250 or 300 volts, and the final stage up to 600 volts. Normally a push-pull modulator circuit would be used to modulate this transmitter. Note the small grid choke to suppress parisitic oscillation.

6. Losses in the tank circuit must be kept low if the Q is to be high, and if power is not to be wasted, insulation must be good quality, coils designed to have a good form factor, and sufficient diameter to reduce resistance losses. High circuit losses are reflected in a high plate current when the amplifier is unloaded.

When an amplifier plate circuit is tuned to resonance, the plate current dips to quite a low figure. If the circuit is detuned, it rises sharply to a very high figure. When an aerial is coupled to the circuit the amount of plate current at resonance rises. You may be asked why this is so.

The valve sees the output coil and condenser as a parallel resonant circuit which, by fundamental theory, presents a high impedance load to it. This high impedance limits the peak current which will flow from the valve, and the plate current meter, which reads average plate current, records this fact by showing a low value.

When the circuit is detuned, it is no longer a parallel resonant circuit, and its impedance as presented to the valve is greatly lowered. As a result more plate current will flow, and, if the circuit is sufficiently detuned, the valve will try to draw as much plate current as though there were no load at all in its plate circuit.

CIRCULATING CURRENT

The amount of valve plate current should not be confused with the amount of RF circulating current which flows within the tuned circuit itself. This is the current which alternates within the coil, and condenser, and is limited only by the resistive losses in the circuit. It can be very high, because circuit losses are generally small, and its value is greatest when there is no load on the circuit. Under these conditions, it takes very little plate current from the valve to maintain quite powerful oscillations inside the tank circuit, and therefore a high RF or circulating current.

Plate current rises when an aerial is coupled because the aerial represents an impedance across the tank circuit of the amplifier. As such it will absorb power just as would an ordinary resistance if connected the same way. In the case of the aerial, however, the absorbed power is used not to heat up a resistor, but to create radio waves which are radiated into space. The aerial absorbs the same amount of power as would a resistance of the same value.

To supply the aerial power, energy is taken from the tank circuit, and to replace it the valve is called upon to supply more power from its plate. It can only do this by drawing a higher plate current than was required before the aerial was connected.

Because the valve is not completely efficient, there is a limit to the amount of power it can supply to the output circuit. The power lost in the valve is dissipated in heat mainly at the plate. When this equals the maker's limit, we can go no further.

LOSSES

It is obvious therefore that it is important to keep all circuit losses to a minimum, in order that as much of the valve's power output as possible is put to useful work in the aerial circuit.

The ratio between the power absorbed by the plate circuit, of the valve and the amount of power taken from it determines the amplifier's efficiency. For a Class-C amplifier this averages about 75 pc.

We come now to a general explanation of how the modulator works. The process of amplitude modulation consists of causing the output power of the final amplifier to vary in amplitude with the modulating signal. Loud signals will cause a big variation, and soft signals a smaller variation. This is why it is called amplitude modulation.

LINEAR CHANGE

This process is brought about by varying the plate voltage applied to the valve, which is why it is called plate modulation.

In a Class-C amplifier properly adjusted, the relationship between change of plate voltage and change in output power is linear. That is to say if we increase or decrease the plate voltage in a series of equal steps, the power output will vary in a similar series of equal steps. This holds good even if we swing the plate voltage right down to zero in a negative direction, and up to twice its value in a positive direction. The modulation process therefore is capable of being carried out without distortion of the audio voltages which bring it about.

We we do swing the plate voltage by this amount, the valve is said to be modulated 100 pc, because we can't swing the voltage more negative than complete zero or cut-off, although we can swing it somewhat more positive than twice its original value.

If we do, however, the relationship between modulating voltage swing and power output will no longer be linear but distorted—it will be higher in a positive direction than in a negative direction. Moreover, the sudden cessation in plate current as it reaches zero may set up a whole train of shock waves which are radiated in the form of "splatter". In other words, we are over-modulating.

The plate voltage swing to achieve modulation is obtained by connecting between the output stage and its power supply an audio choke or the secondary of a modulation transformer, across which voltages from the modulator are applied. Our circuit shows a transformer because it is most often used.

RESISTANCE LOAD

The transmitter output stage now becomes the load for the modulator valve, and can be considered as a pure resistance with a value equal to its plate voltage divided by its plate current. If these are 1000 volts and 100 milliamps the value of resistance will be 10,000 ohms.

All we need do now is to use a modulator valve with enough output to develop 1000 volts of audio across this 10,000 ohms resistance.

This "audio" voltage is, of course, an alternating voltage, and on positive peaks its 1000 volts will add to the 1000 positive volts already supplied to the valve, thus making

? ? ? ? ? ? ? ?

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IN THE

DECEMBER ISSUE

FOR

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volts all told. On the nega-
peaks, the 1000 audio volts will
el out the 1000 positive volts
he valve and reduce the effect-
voltage to zero. Thus we have
ng the amplifier plate from zero
wice its operating voltage, and
eved 100 pc modulation.
ow when we vary the effective
age to the output stage, we also
the plate current it will draw,
this variation is also linear.
en the voltage doubles, so does
plate current, and when it falls
zero, the plate current does the
e. Thus, on the positive peaks
modulation, when the valve has
e the voltage and draws twice
current, its instantaneous power
put will be four times as great
without modulation.
Note that these are instantaneous
ues—that is they are reached only
a tiny fraction of a second when
modulating voltage hits its peak.
e next instant the process has
ersed, and the valve draws no
rent nor has it any effective volt-
e.
t all happens so quickly that
positive and negative excursions
lance out, and the plate meter,
ich, of course, cannot follow the
tremely rapid changes, will not
ow any alteration in the average
ate current drawn by the valve—
at is if the stage is operating per-
ctly.

OUTPUT

It is quite obvious that the aver-
e increase in RF output at 100
modulation will not equal the
stantaneous values, but will be the
modulated figure of 100 watts,
us an extra audio power of 50
atts, an increase of 50 pc. There
ill also be an increase in the
alve's plate dissipation equal to 50
of its unmodulated value, be-
use we have increased the power
rawn from it by this percentage.
hat is why operating ratings for
odulated service are lower than
ose for telegraphy. They are re-
uced so that at full modulation the
xtra dissipation does not bring the
otal amount to more than that set
own for the valve.

We said just now that 50 watts
vill be needed to modulate the 100
vatt input 100 pc. How do we get
his figure?

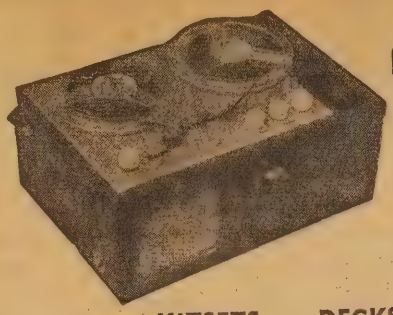
To find out, we must consider the
xtra voltage and current supplied
y the modulator, not in terms of
heir peak values, but of their Root
Mean Square or rms values. These
re .707 of the peak values, which
n our example are 1000 volts and
00 mills. The rms figures for these
will be 707 volts and 70.7 mills,
nd if you work out an Ohm's law
um you will find this represents
a power of 50 watts, the product
of the two.

This is how we arrive at the re-
lationship between the amount of
audio power and the plate input
power. It is 50 pc

IMPEDANCE RATIO

To make full use of the modu-
lator power, we use the transformer
to give the correct impedance ratio
between the load required for the
modulator for full output, and the
load represented by the modulated
RF amplifier, in our case, 10,000
ohms. If for instance the audio
load for the pentode is 5000 ohms,
then the modulation transformer
will have a step-up ratio of 2-1.

(Continued on Page 109)



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THE USE OF CRYSTAL PICK-UPS

Despite all that has been written on the subject, a great deal of confusion still exists about the use of crystal pickups, with compensated high-gain amplifiers. Because of the confusion, the results obtained from such a combination are often disappointing and this article examines, once again, the possible reasons for it.

by Neville Williams

IF one were to classify the troubles which follow in the wake of this confusion, they would be listed as follows:—

(1) Volume control too abrupt in its action.

(2) Harsh reproduction on signal peaks.

(3) Unnatural bass response.

(4) Excessive motor rumble.

Such effects are often taken as evidence that the pickup or the emplifier is faulty, but this need not follow. As often as not they are simply the result of interconnecting the two in a way which loads the pickup incorrectly and, at the same time imposes an excessive signal on the first grid in the amplifier.

Poor tonal balance and overloading on peaks are the natural result.

BACK TO FUNDAMENTALS

To understand these statements one must appreciate the distinction between what we have referred to as a "compensated high-gain amplifier" and one of the conventional variety.

One must appreciate, too, the fundamental difference between a piezo-electric (crystal) type of pickup and the magnetic variety (moving iron, moving coil or variable reluctance).

The conventional type of audio amplifier — and this includes most receiver audio systems—is designed to give full output with an input signal of not less than about 0.25 volt.

This eliminates the need for a preamplifier stage, avoids any problems with hum and microphony and also allows the volume control to be placed right at the input circuit and ahead of the first grid. This is a most important point.

NO OVERLOAD PROBLEMS

In operating the control, the user automatically selects the proportion of input signal necessary to drive the amplifier to the required output. A high input signal, as from a sensitive pickup or radio tuner, is simply countered by turning the volume control back a little further and there can be no question of it overloading an early stage in the amplifier.

Then, again, a conventional amplifier does not normally contain any elaborate or pre-set frequency compensation. Its design assumes that the input signal from tuner or pickup will be reasonably balanced in terms of bass and treble response.

Crystal pickups mate very nicely with amplifiers and audio systems of this "conventional" pattern and, for this reason. have come to be used almost universally in domestic radiograms and simple amplifier systems.

They deliver an average signal in excess of 0.25 volt and can therefore drive such amplifiers with something to spare.

In addition, their naturally rising bass response, when fed into a high value of load, complements the loss of bass in recording and gives an overall balance that is regarded as acceptable by most listeners.

Unless otherwise stated, all manufacturers' literature on crystal pickups is based on the assumption that the pickup will be used in this ordinary way, taking advantage of its high output and its rising bass response.

In line with this, the "normal" load for a crystal pickup is usually quoted at about 0.5 meg. and never less than 0.1 meg. Any simple networks that the manufacturers might suggest for particular types of pickup are likewise of relatively high impedance.

It is logical to follow such recommendations wherever a pickup is to be used with a conventional amplifier system.

If we could end the story there, as we could a few years ago, it would be a simple matter. There is more to it, however.

With very rare exceptions, crystal pickups are mass-produced for the "popular" market. They must therefore be robust, must deliver a high output voltage, and, without special compensation, provide an acceptable balance between bass and treble response.

That they achieve these objectives is evidenced by their wide acceptance and by the variety of brands and types which are at present in use.

However, the more avid amplifier fans are not convinced by airy claims of "absolute fidelity" and are prone to ask pointed questions about frequency response limits, deviations from reference, distortion level, &c

And here the going gets tough for the popular crystals!

Though fulfilling their prime purpose, few, if any, of them can boast the near-perfect response curve and other characteristics which the keen amplifier fan is likely to want. Quite naturally, they begin to ask about pickups of more specialised design.

The position is further complicated by the fact that the recordings themselves vary in their frequency content and require different degrees of compensation for optimum results. The pickup can do no more than impose a single compromise frequency law, leaving the records to vary from it as they will.

While the average listener may ignore these variations, an enthusiast will certainly not be prepared to do so.

The answer to this double problem involves two significant steps: (1) To use a pickup whose design emphasises fidelity rather than output and self-compensation. (2) To provide an amplifier with as much extra gain as required and with in-built circuits to give various pre-set degrees of bass and treble compensation.

This is the basis on which most of our Playmaster circuits were designed, as well as certain other amplifiers and radiograms. It is the basis, too, for some of the excellent commercial amplifiers which are now available to music lovers. All of these provide much higher gain than usual and in-built frequency compensation.

A CLOSER LOOK

It may be helpful to look a little more closely at the design of these more specialised pickups and amplifiers. Let's look first at pickups.

If it is assumed that output voltage is only of secondary importance and that self-compensation is not required of the pickup, the piezo-electric (or crystal) principle ceases to have any special advantage.

In fact, it may rightly be said that the crystal is at a definite disadvantage because it is difficult to make it deliver an output voltage proportional to the groove velocity characteristic of the original recording.

The crystal element tends rather to be amplitude conscious, and the law of the pickup as a whole has to be modified by "doctoring" the compliance of the stylus system and by feeding the pickup into a complex output load. Both schemes are possible but sufficiently difficult to raise the question of "an easier way".

Against this, pickups which rely on magnetic properties have a natural velocity characteristic, which is very convenient where all compensation is to be effected in the amplifier.

Into this class of pickup come the conventional moving iron magnetics, the moving coil or "dynamic" types and the variable reluctance types.

MODERN COMPENSATING PRE-AMP

hile it does not follow that all mag-tic pickups are good — some very or examples have been released— is certainly true that the majority high performance pickups use one other of the above principles.

In some cases, their mechanical nstruction is quite simple, but is very simplicity and lack of mass the moving parts is reflected in a nooth conversion of stylus velocity electrical output.

The output is, however, invariably iite low, when compared with popu-r types of crystal pickup. It may ave a nominal value as low as 10 illivolts or up to 100 millivolts, ith 50 as a fairly typical average.

OMPENSATION NEEDED

In addition, the output voltage re-ects the velocity characteristic of ne recorded groove and invariably equires substantial boosting in the ass region. This may range from 0 to 20 decibels at 50 cps, depending n the class of record being played.

Then again, when playing micro-roove discs, the output at 10Kc is ikely to be from 10 to 15 db above eference, requiring an equivalent mount of treble cut in the amplifier.

When designing an amplifier to neet these requirements it is usual o have the pickup connected directly nto the first grid circuit, on the ssumption that the input signal will ever be high enough to overload he first valve.

The input grid resistor is usually et at between 20,000 and 100,000 hms, being much lower than recom-nended for crystal pickups, but quite ypical as a load for magnetic types.

The necessary circuits for volume ontrol and frequency compensation ormally follow this first stage, the igher level minimising the chance f noise and hum pickup.

In the Playmaster series of am-lifiers (except Nos. 4 and 6), and in everal commercial units of like de-ign, the preamplifier and compen-ation circuits, together with addi-ional tone control facilities, are oused in a small control cabinet eparate from the main amplifier. This serves the double purpose of eeping the control shafts accessable or cabinet mounting and also of eeping the sensitive input circuits away from transformer hum fields.

OW INPUT

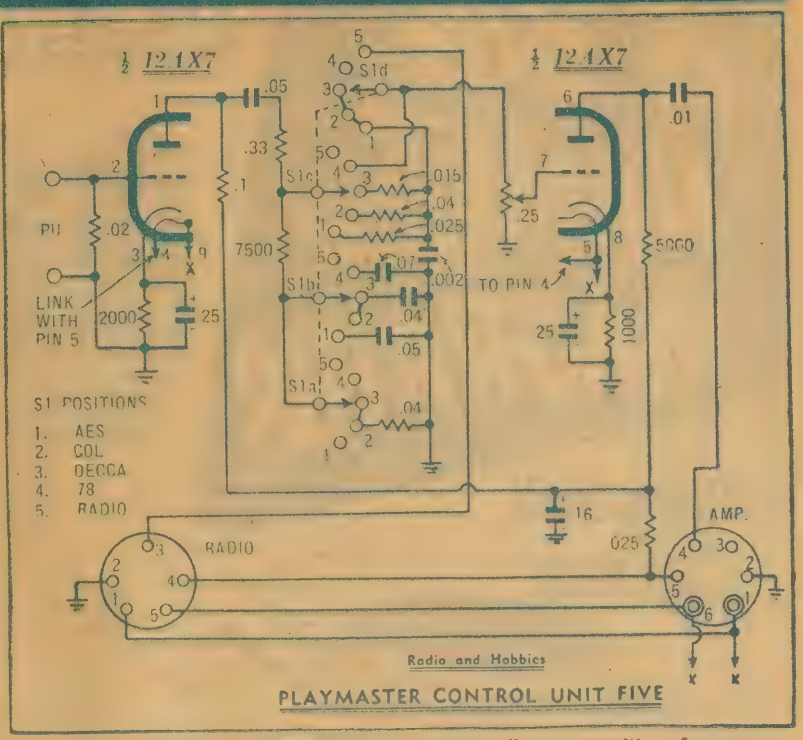
For our present discussion, how-ever, the vital point is that such amplifiers are designed on the as-sumption that the pickup input cir-cuit will never be called upon to handle a signal greater than one would expect from a magnetic pick-up. Further, that the signal will re-quire complete bass and treble com-pensation in the amplifier.

Present practice in record repro-duction may, therefore, be divided into two fairly distinct groups, as under:

(1) Equipment using a crystal pickup, with high output and rising bass response, fed through a high resistance volume control to a con-ventional amplifier system.

(2) Equipment using a low output magnetic pickup, feeding directly into a preamplifier and tone com-pensating stage, thence through a volume control to the main amplifier.

Provided the equipment conforms to one grouping or the other, no great difficulty is likely to arise.



This Playmaster control unit 5 would be an excellent proposition for anyone wishing to adapt an existing amplifier for use with a magnetic pickup in the 50 mV output class.

What can and does lead to confusion, however, is a mixture of two techniques—the use of a low output magnetic pickup with a conventional amplifier, or of a high output crystal with a high-gain compensated amplifier.

The first of these ill-assorted mixtures was quite commonplace a few years ago when lightweight pickups first made their appearance.

NEW MAGNETICS?

Many enthusiasts replaced their old-style pickups with new lightweight magnetics, expecting a much wider frequency response. What they got, in fact, was a very disappointing kind of reproduction which usually earned the description "weak- noisy and thin".

The reason for this should be quite obvious. The new pickups achieved their lighter weight, higher needle compliance and wider response by scaling down the magnetic structure. The output voltage came down with it—hence the accusation of "weak" reproduction.

The wider frequency response meant more high-frequency output, and with it more scratch from old and imperfect records. Hence the term "noisy".

And, finally, the pickups gave no inherent boost to the bass register, with the result that the reproduction sounded very "thin" indeed.

The only lightweight magnetics which were in any way successful with ordinary amplifiers were the few which were supplied with step-up transformers, heavily loaded to favor the bass end. These were the exception, rather than the rule.

Though pickups have come and gone in the meantime, the same position holds today. Magnetic type pickups (moving iron, moving coil or variable reactance) are completely unsuitable for direct use with conventional amplifiers and audio systems.

At the very least a preamplifier stage must be added ahead of the main amplifier, giving several times gain, about 15 db boost at the bass end and a large amount of treble cut for playing microgroove records. A logical step would be to build one or other o fthe Playmaster control units and feed it into the existing pickup input terminals.

Several such units have been featured from time to time, ranging from the relatively simple No. 5 unit (August, 1954, page 75) to the high-gain unit described elsewhere in this issue. Discussion around this unit will put you into the picture regarding gain requirements.

ANSWER IS A CRYSTAL

If the construction of a preamplifier or control unit is beyond your ability and you still want to use an existing conventional amplifier, then only one course is left open. You will have to buy a lightweight crystal type and take advantage of its high output and rising bass response.

And this brings us to what is at present the most frequent source of confusion—the use of high output crystal pickups with modern, compensated amplifiers.

How the problem arises is easy to understand. An enthusiast decides to build himself a new amplifier and is naturally attracted by designs like the "Playmaster" series, which offer

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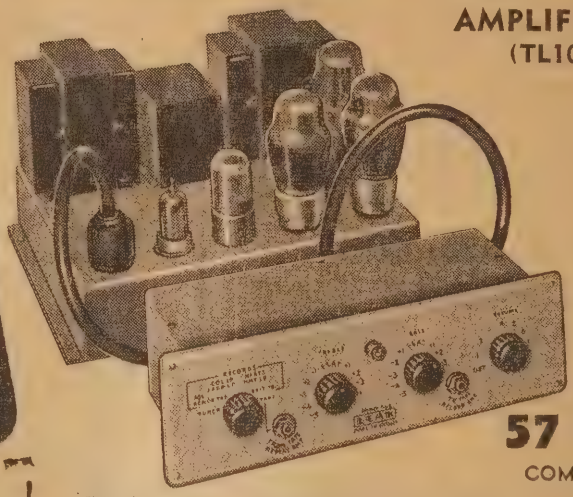

57 GN COMPLETE

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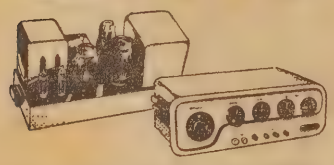
QUAD II



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ccurate degrees of record compen-ation, additional tone control facili-ies, &c., together with the kind of erformance that one expects of odern equipment.

Alternatively, he may be attracted o a radiogram design or to a single-nit amplifier offering more-than-sual gain and better-than-usual acilities for frequency compensa-ion.

Having built the equipment of his hoice, it then remains to secure a ickup and motor, and this may be raught with difficulties.

PRICE PROBLEM

He may be suspicious of "bargain rice" magnetics—and rightly so, in ost cases. The dearer magnetics re dearer indeed, and high quality otors are even further out of his each. As often as not, our typical nthusiast placates his pocket (for he time being) and his family by uying an ordinary record-player or ecord-changer using, almost for cer-ain, a crystal pickup.

Whether it works out this way or ot, the problem is there: How to use crystal pickup with a modern, com-ensated amplifier. If they are con-ected together wrongly, troubles nsue of the kind listed right at the eginning of the article—critical olume control, overload on peaks, nnatural bass response, motor umble.

To understand how such troubles an arise, it is merely necessary to ecall the design basis for a special-sed amplifier: (1) The pickup feeds irectly to the preamplifier grid and ust not be allowed to overload it; nd (2) the pickup must not be al-owed to develop its own bass boost r attenuate the treble if, as is usual, he preamplifier has built-in compen-ation to achieve these two things.

When used under normal load con-itions, crystal pickups will not nor-ally satisfy either requirement. In erms of output voltage, they may de-liver anything from about 0.1 to 1.0 olt RMS from a 1000-cycle micro-groove test track.

Experiment has shown that peaks of output on loud signals may run to nearly 10 times this nominal value so that, depending on the type and brand of cartridge, one must expect signal peaks of from 1 to 8 volts from microgroove records, and pos-sibly higher again from heavily-recorded 78's.

BASS BOOST!

Again, it is not unusual to measure an output of plus 4 or 5 db at 40 cps from a crystal pickup playing a microgroove test track. This means, very simply, that such a pickup is overcoming the entire loss in the record with 4 or 5 db to spare—a total boost of about plus 18 db.

It is not difficult to see how the bass would sound "unnatural" and the system be prone to rumble if a further 15 to 18 db is applied in the amplifier!

One must therefore be prepared to discard makers' recommendations about load and compensation except for the very rare instances where filters are suggested to achieve "constant velocity" characteristics.

To date, we have simply suggested that the output of a crystal pickup will be reduced and its bass response attenuated by feeding it into a low value of load—typically from 20,000 to 50,000 ohms.

Broadly this is true, and many readers have been perfectly happy with the result obtained when such a pickup is connected straight into one of the "Playmaster" control units, with its relatively low value of input resistor.

Indications are, however, that the reduction in output is not always sufficient to avoid overload on peaks. Again, the degree of bass attenuation given by any one value of load is not adequate for all pickups.

Tests we have made indicate that some pickups approach "constant velocity" characteristics with a load of about .05 meg. In other cases, the load has to be reduced to as low as .02 meg before the same kind of law is achieved.

The load value also influences the pickup's behavior in the treble register, lower values of load tending to accentuate the treble in relation to the 1000 cps reference point. Whether or not the treble goes beyond constant velocity characteristics is entirely dependent on the pickup's design.

The seemingly obvious step, from our point of view, would have been to test each type of pickup and derive for it some suitable compensating network which would counter the effect of its internal capacitance, compliance and resonance, and give it the characteristics of a true constant velocity pickup; in fact, make it look like a magnetic.

COLOSSAL TASK

However, quite frankly, we took one look at the number of cartridges which have been used by our readers and ruled it out as completely impossible. Before one can even start to derive a network, several pick-ups of each type have to be tested before one can be sure that the work is being done on a typical example.

The only alternative was to suggest a simple circuit which will apply to any crystal pickup and overcome the immediate problems of overload and disproportionate bass response. Special peculiarities of the pickup are therefore ignored.

We suggest you follow this procedure:

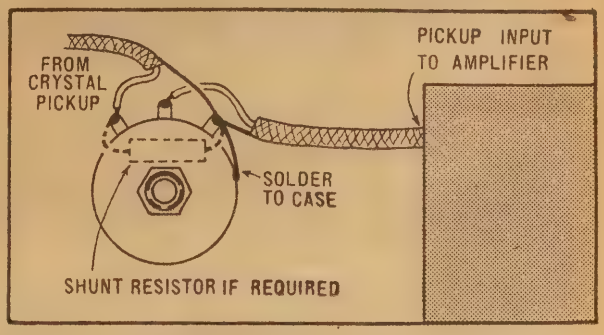
Check your amplifier to see whether the pickup feeds directly into the first grid circuit. If it does, you can assume that a volume control will have to be wired between the pickup and the input terminals. The control need not be permanently accessable, because it will be pre-set to a position which avoids overload in the first stage and allows the main potentiometer to exercise a smooth control between minimum and maximum volume.

Now check the operation of the circuit—or read the article covering it—to ascertain whether the amplifier contains any pre-set bass boost and treble de-emphasis, as distinct from bass and treble tone controls. This will determine the value of the pre-set potentiometer.

Thus, if you have built the "Playmaster" No. 6, you will find that it does not contain any pre-set compensation. There are bass and treble controls, to be sure, but these are intended to provide minor adjustments to tonal balance—not to offset any large-scale deficiency in compensation.

Therefore, a crystal pickup feeding the "Playmaster" Six would logically be allowed to develop its natural bass response, and a typical load for it would be 0.5 megohm. A 1.0 meg potentiometer, in parallel with the 1.0 meg grid return resistor, would give this net value.

Had there been no grid resistor, an 0.5 meg potentiometer would be used, pre-set to an appropriate position.



Input circuit overloading can be eliminated by wiring a potentiometer between the pickup and the first grid. A value of 50,000 ohms is a good starting point being shunted to a lower figure if the bass response is still too prominent.

OTHER CASES

In all the other "Playmasters", and in various other circuits, complete pre-set compensation is provided in the plate circuit of the preamplifier stage. In such cases the pickup must NOT be allowed to develop its own bass boost.

We suggest, therefore, the use of a .05 meg potentiometer as a pre-set control. This will divide down the output to any degree you may require and it will also reduce very substantially the pickup's bass response.

In fact, with quite a few pickups the bass response will be just about right.

However, if the bass still sounds too heavy at normal room volume and with any auxiliary bass control at "normal", it is an indication that the load on the pickup has to be reduced to something less than .05 meg.

Try connecting resistors in parallel with the potentiometer ranging from about 0.1 meg to .04 meg. This latter value will reduce the net load on the pickup to about .02 meg, which is as low as it should ever need come.

So there it is. We trust that, having waded through this rather lengthy discussion, you have gained a much clearer idea of the relationship of a pickup to its associated amplifier.

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TRADE REVIEWS AND RELEASES

HIGH-QUALITY SPEAKERS

FROM SIMON GRAY

World famous Wharfdale speakers ranging from 12-inch down to 5-inch types have been tested during the past few weeks with most impressive performances being obtained from them all.

HEY are made at the Wharfdale works in England and designed by W. F. Briggs, author of ny books on sound reproduction i loudspeakers.

Most versatile of the range is unibtedly the Super 12/CS/AL full nge speaker, which has a high ut rating, full range, and a mag- assembly with a total flux of),000 lines.

Mounted in a large enclosure, this eaker gave a performance rarely

The Wharfdale Super 5, frequently used as a high effciiency tweeter.

qualled by a single speaker at any ice.

Particularly good was its clean ndling of transient response and s freedom from peaks.

The high frequency response is btained by the use of a bakelised pex, while a cloth suspension for e cone allows a low resonance and articularly clean bass. At all freuencies, the speaker handles high puts with ease, and is suitable for e largest home amplifiers.

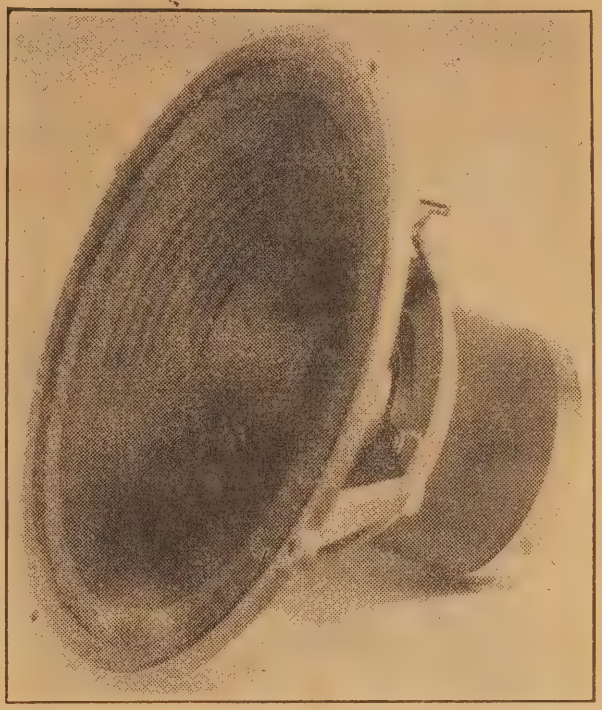
A particularly valuable feature is s extremely high sensitivity which llows the amplifier to be run at educed output and lowered distorion.

As with all speakers of this type, requires correct mounting to give est results, and, although the price not low, it is in keeping with s high class, and robust finish. t is a speaker which literally speaks for itself".

Of similar quality, with suitably nodified performance, are the 10, 8, nd 5in models. The latter is particularly good as a high efficiency weeter in multiple units, and the -inch speaker is often used either s an extended range tweeter or a nid-range speaker.

Where full range is needed, the 0-inch model is a miniature copy f its bigger brother.

Included in the batch was a 15-inch Baker low frequency speaker which amply demonstrated the value of a large cone area, when used as a "woofer" with one of the smaller Wharfdale units.



The famous Super 12/CS/AL wide range Wharfdale, a speaker of the highest quality.

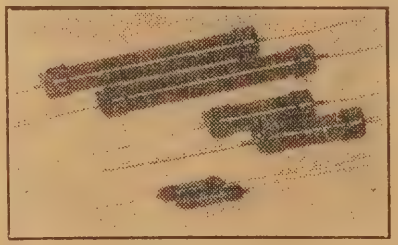
Without doubt, all these speakers will be welcomed by Australia's growing army of high fidelity enthusiasts, and claims for them appear to be fully borne out in use.

I.R.C. HIGH-STABILITY RESISTORS

Designers of precision equipment will be particularly interested in a recent announcement from Messrs. W. J. McLellan, to the effect that they are releasing immediately a range of high stability, carbon type resistors.

THESE resistors are additional to their normal general purpose range, are somewhat dearer in price and manufactured by a completely different process.

In the high stability types, the carbon element is deposited and bonded on to a ceramic rod, then brought to the required value by cutting a spiral groove around the surface, of the required length and pitch.



A group of the new resistors in ½w., 1w. and 2w sizes.

This method allows the resistors to be produced to close tolerances, which they hold for long periods and under a variety of conditions. They are intended for use in metering, in electronic and some television applications where ordinary metallised resistors are not sufficiently stable and where wire-wound types are too expensive.

The manufacturers are making available immediately through the radio trade, ½-watt, 1-watt and 2-watt resistors in a variety of values. Developmental work is also proceeding, which will widen the choice of wattage and resistance values.

At present the resistors can be supplied to tolerances of 1 pc, 2 pc, and 5 pc, in wattages as already mentioned and in values from about 100 ohms to several megohms.

A leaflet containing detailed application data and curves is available from the manufacturers, Messrs. Wm. J. McLellan & Co. Pty. Ltd. 126 Sussex St., Sydney.

OFF THE RECORD — NEWS & REVIEWS

Last month I commended very highly a Nixa recording of the Planets. This month anothe Nixa takes the honors—an electrifying performance of Walton's Belshazzar's Feast. It is work which lends itself to brilliant recording, and there is very little to criticise in the way i is heard here.

By JOHN MOYLE

WILLIAM WALTON — Belshazzar's Feast, by the Philharmonic Promenade Orchestra, the London Philharmonic Choir, and Denis Noble (baritone). Conducted by Sir Adrian Boult. Nixa NLP 904.

Walton's work is really an oratorio, although it has little in common with those of Handel and Haydn. It is based on the dramatic story of Belshazzar, the king of Babylon, who at the height of his glory, saw the hand writing on the wall, telling him of his doom And of how his kingdom was divided, and himself slain.

The story is made to order for Walton, whose briliance is at its best in creating the pagan color of the court, the savage praise for the gods of Babylon and the king, the terror which followed his denunciation, and the exultation of the Israelites.

And yet he is not less effective in portraying the grief of the exiles, who, in a strange land, could not sing the songs of Zion for their masters.

The approach is a shattering one to a listener, who has always heard oratorio in the classical torm. Walton uses the machinery of Gershwin, Stravinsky, even Strauss, and mixes them with his own ideas of syncopation and strong imagination.

The total effect is a vital and distinguished work, balanced in its dramatic progression, concise in its musical statement, and complete as a short story is complete, with nothing wasted, nothing distractive from the point, everything contributing to the great climax he achieves.

Such a work is made to order for brilliant recording. We have here the balance, clear definition, wide range, and sure handling that make the five star record.

In fact one of my few criticisms is that the periods of full orchestral and choral pressure are held rather too long. The use of cymbals, for instance, is inevitable in such a picture, and they are so vividly recorded that I became a little weary of ducking for cover every five seconds. But the score demands it, and the recording allows it, to its credit.

Denis Noble, who is the soloist, is an old hand at this work, but I thought he was at times a weak spot. The choir, too, has obviously been drilled in the importance of sibilants in their remarkably clear diction, and once or twice their prominent final consonants failed to hit the dot at the same time.

But on the whole it is a remarkably fine record, which I think every serious listener should have. Hi-fidelity fans will be in for a real thrill. And, as a final word of commendation, the full text as written by Osbert Sitwell, is included on the cover so that you may admire how well the choir sings it.

I doubt whether you will ever hear a better Belshazzar than this.

BRUCKNER—Symphony No. 6 in A major (original scoring); 150th and 112th Psalms for choir and orchestra with Hilde Ceske (soprano). Played by the Vienna Symphony Orchestra, with the Vienna Kammerchor conducted by Henry Swoboda. Westminster WAL201.

Bruckner and Mahler have something in common—their protagonists are as fanatical as their op nents. They are variously descri as sublime spirits and interminа bores. It might be safest to o that they are both, but it is li wise true.

I doubt whether this could classed as the best of Bruckn symphonies, but I have never he it before, and the record notes it is the first time it has been corded.

I have nothing whatever aga the recording, nor against about the score either, but I cannot agree with those who think Bru ner could have condensed his m ter 50 pc and enormously impro it.

Listen carefully to the sec movement of this symphony, and if this isn't so.

The truth is that neither Bru ner nor Mahler had the stature thought to sustain such huge mu cal structures which, for all th purple patches, sag inevitably intervals.

No greater injustice was ever d to Beethoven to class Brucki among the "B's". Beethoven could have made the distance with little to go on.

In the knowledge that this is o personal opinion, however, I m credit these records with a typi Vienna performance and an equa good recording. Someone has stru a good balance between forwar ness, reverberation, and the nec sity to preserve the resonance some effective string bass. If y are interested in Bruckner by means hear this performance.

Of the two Psalms, the 112th easily the best, and contains so very impressive choral singing. T 150th seems poorly balanced contrast and not to be compared w it.

Unfortunately, some surface swi made an AES curve a little uncom fortable with high gain, but I shou say the discs were made for N anyhow, and sound good on t setting. It's strange, but the hi surface noise seems to be on t tape, as it commences with t music. There is also a little inte groove intermodulation, but on t whole this album as far as Bruc ner is concerned is a valuable r lease.

HARTMANN—Symphony No. for String Orchestra. Played the Symphony Orchestra of the Be gian National Radio Institute, Bru sels. Conducted by Franz Andr Radiola-Telefunken LS6021.

Hartmann is obviously one of school which deliberately sets o to excite the ears and the ner ends with the most exquisite placed dissonances calculated have the highest value in music irritation.

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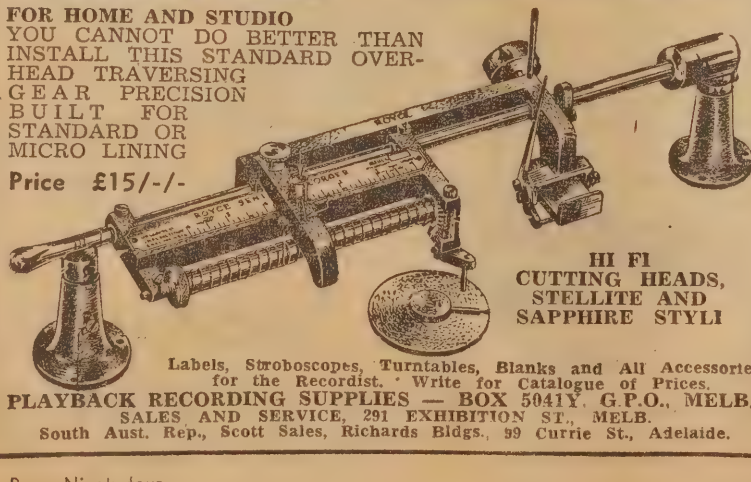

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amplifier built to produce the excruciating form of scale dis-on.

m firmly convinced that appre-n of this calculated violence to liatonic has nothing to do with ligence or musical appreciation. just a matter of how much nance one's brain can stand out being revolted.

it were not so, we could stand oved in the presence of any unt of distortion. This music is ely distortion written to order, little else.

am only stating a fact when cord that it reduced one mem- of my family to tears. I am ly incapable of assessing any cal value it might have, but willing to imagine this may be ighest recommendation.

have nothing but admiration for performance and recording. If are a real modern, don't pass y. I cannot speak too highly man who can invent such ds.

CHARD STRAUSS—Der Rosen-lier Waltz—Dance of the Seven s from Salome Opus 54, played the Stadium Concert Orchestra lew York conducted by Alexan- Smallens. Festival - Decca 10-426.

extremely vivid and lively re-, apparently one of the first erican Deccas, which Festival be releasing in Australia. It rather a high degree of rever-tion which does break down clarity at times and push the ermost instruments a little too away.

the other hand it has an at-phere which I thought went well the music on both sides. Par-larly that of Salome, which I ght especially good, although obviously exploited purely as ow piece for which its brilliant estration suits it.

y only real criticism is that the ace noise is high enough to be ceable, even with an NAB set-which seems to be the best.

AYDN — Sinfonia, Concertante flat major Op 84; Cello Con-o in D major Op 101 (original ion), played by the Pro Musica estra, Stuttgart, conducted by Reinhardt, with Walter Reich- (cellist). Festival-Vox CFR12-

s the jacket points out, we are to hearing music of this type ed by a large symphony orches- and when we receive it in more modest form in which it written, we are apt to notice lack of weight.

his I thought most noticeable in case of the 'cello concerto, which ally receives much more solid king.

is here played conscientiously with care, but not with as much gination and lightness as it can d. These remarks apply equally he cellist, and I am afraid the result is to become a little on dull side at times.

he cello isn't the easiest of in-ments to manage, but even small s in intonation are hard to over- on a record, and the small emble makes it sound extremely vard at times.

ut then all the music is good it's by no means a hard disc listen to. Surface noise is low ugh to be inaudible and it plays nly throughout.

his fact shows up most favorably ing the cello cadenzas, for in-stance, where the recording is at its best. For some reason there is a low tape hum in the second and third movements.

VIVALDI—Violin Concerto in E flat major, Violin Concerto in G minor. Played by Peter Rybar with the Vienna Symphony Orchestra conducted by Rudolf Moralt. Westminster WL-5006.

To my mind the only flaw in these discs is a rather prominent range of notes which are projected from the violin and which are rather hard to tame. It is quite probable that these are characteristic of the instrument for they are in the middle of its register, and it has that kind of tone. I think it would have been better to have worked for a less forward recording and given it a little more "air".

Apart from that both the music and performance are quite delightful. Vivaldi was a giant in his day, and remains one of the brightest lights of the "golden era of violin playing and composing". We will go far before we find a more perfect piece of work than the Adagio of the G minor, for instance.

The violin is handled best in the E flat, perhaps because the player here shares with the harpsichord, and there is an obvious change in general placement.

This record has one of Westminster's best surfaces, and there is scarcely a whisper from it. It plays best with NAB.

HAYDN—String Quartet in F major op. 3 No. 5 (The Serenade), String Quartet in D major Op. 64 No. 5 (The Lark). Played by the Kalki Quartet. Radiola-Telefunken LS6019.

Two popular Haydn quartets competently played on a single 10in record with a particularly clean surface sounds a good buy, and that's what this record is.

The recording maybe isn't up to the extremely high standard set today by the very best string groups, but then few are. It plays best on the EMI setting with a bit of bass reinforcement which really makes it NAB. The quality isn't absolutely even throughout, indicating some changes somewhere between sessions. The "hornpipe" movement of the Lark has one or two indefinite moments including the recording but these are not serious.

The surface noise is very low, and altogether it is a very good, better than average stock record.

JOHANN SEBASTIAN BACH —Italian Concerto in F major arranged for orchestra. HANDEL—Concerto for Organ and Orchestra No. 10 in D minor with Rene Tellier (Organ). Played by the Symphony Orchestra of the Belgian National Radio, Brussels, conducted by Franz Andre. Radiola-Telefunken LS6027.

The Bach is an arrangment for orchestra from the original from the harpsichord. It is nicely done, with due regard for the style, and the period, and yet by no means archaic. There is a preoccupation with woodwind, used to good effect and beautifully recorded.

The second movement is particularly effective.

The organ concerto was one of those so well done by Thalben Ball when he was in Australia. There are various versions of these concertos, and this is different from the

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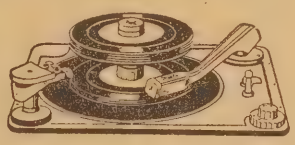

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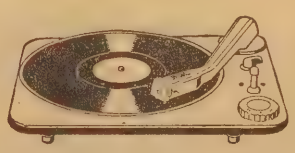

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one used by Thalben Ball—not so impressive by today's standards but probably more authentic.

The organ and orchestra preserve a good balance without losing clarity. The recording I would say is made in a medium sized studio which is probably why it is so clear, and played with a chamber music air much more authentic than in a large hall of today.

As with most Radiola records it plays best with either EMI or NAB curves. Frequency range is good but not extremely high. A little shrillness on the strings stems, I think, from the deadness of the studio and the mike placement which goes with it.

But its a most attractive disc on which the surface noise is not high enough to be noticeable.

CHRISTMAS SONGS—Eight carols sung by Hilde Gueden soprano with the Chorus and Orchestra of the Vienna State Opera, conducted by Richard Rossmayer. Decca LXA3117.

This is a most attractive record—popular in conception but classic in execution. By that I mean that the eight Christmas songs or carols will appeal to everyone and some such as O Tannenbaum and Stille Nacht are particularly well known. The idea of a soloist with a choir obbligato is also a popular device and is widely used with less exalted material.

The execution is classic because the soloist, choir and orchestra are first class, and the arrangements are admirable in their restrained use of traditional Christmas extras such as the gongs which always creep in somewhere. Certainly they are included here but even I managed to take them without offence.

The recording is a really good one, well balanced, with good overall range, and almost completely clean. The average machine would certainly play it that way. The surface noise is virtually absent. It is pressed in Australia as are nearly all Decca records now released here.

A very good disc you could play all the year round.

DEBUSSY — Suite Bergamasque. RAVEL—Gaspard de la Nuit. Played by Friedrich Gulda, piano. Decca LXTA 2817.

The playing on this record is remarkable for its extreme sensitivity, delicacy, and tasteful delivery. It lacks almost entirely any real body, so that we are presented with a shadow or at the most a pastel-shaded reflection. This may be very charming, but I imagine one will require more than this if the competition of men like Gieseking is to be faced. Or is that asking too much?

Some of the effect might be due to the recording which has a strangely pale effect matching the playing. In the Ravel it displays little drama or even weight.

I know that many like this somewhat nebulous atmosphere where Debussy and Ravel are concerned. I'd advise all such to hear this disc, which, judged in this light, has many good points. But it didn't impress me as a front rank recording.

LISZT—Concerto No. 2 in A major with the Philharmonia Orchestra, conducted by Walter Susskind—Sonata in B minor. Play by Wittold Malcuzynski. Colum 33CXH06.

A mighty and brilliant work t and likely to appeal to a wide vari of listeners. It is the second i pressive performance on my sh the other being a Westminster Edith Farnadi, and there have ready been arguments as to which the better.

It is certain that the Westmins is hard to beat, and I doubt whet this one does more than edge i the same class. But that in its is a compliment.

Malcuzynski's piano is more mote than Farnadi's, and I rat liked the sense of "air" which gives out. There is ltitle doubt the pianist's brilliance. The orc estra gives him strong and we balanced support, with enough verberation to generate an attracti depth.

In the sonata the pianist sho up best in the brilliant passages elsewhere he languishes too muc for, although Liszt was famous t his tender moments, they are n as pale as they are here. My ge eral comment would be that it lac somewhat in size and cohesion, b it is a big piece which isn't ea to play adequately. The piano a little remote, but quite convin ing. The bass lacks some boc which is not completely replac with extra boost.

Except for a slight swish at t commencement of the concerto t surface noise is quite low. T record plays cleanly for the mc part, with a doubtful half-inch the end of the concerto, due to t extremely high amplitude. The is some good orchestral weight in restrained kind of way—some go brass, too.

CHOPIN—Sonata in B Flat min (Funeral March), Nocturne in major, Etude in F major, Andan Spinato and Grande Polonaise Bri liante. Parlophone PMAO 7001. Pla ed by Bela Siki.

CHOPIN—Four Ballades in minor Op 23, in F major Op in A Flat major Op 47, and in minor Op 52. Parlophone PMAO 100 Played by Bela Siki.

There are many ways in whi to play Chopin, or should I s that he is played in many way This pianist loses no opportunity show his control over dynamics, the strength of his arm, which capable of no mean blow. You m tire of so much clang tone, a though the more reflective pa sages are played with good effe and are crystal clear.

In his approach each piece treated as being of heavy signi cance, whereas not all of them a There is, therefore, a samene which Lipatti for instance avoic and which could cause all but av Chopin fans to tire a little aft a steady session. The touch is firm than Lipatti's, but it is also matt of fact. The B minor Sonata a good example of this straightfo ward competence.

These remarks apply pretty w to all the Chopin listed here, b they are not meant to imply th Siki is hard to listen to. Rath are they intended as a thumbna impression of the kind of Chop he produces.

The piano tone in general is qui

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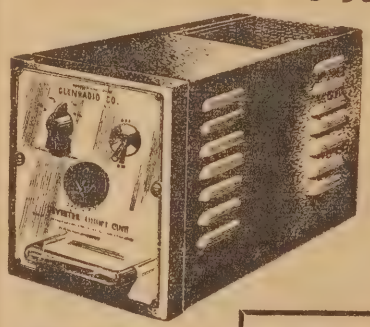

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od, and the grooves have taken impact well, except for some ctions of the Ballades. Some of doubtful tone here may have en due to stylus wear, but it didn't ow up on the other disc. Both ck the full bass of the best piano cords of the day, but balance is herwise OK, and doesn't drop out the top end.

Surface noise is quite low but not tirely absent.

VERDI — La Traviata with Licia Albanese (soprano) Jan Peerce (tenor) Robert Merrill (baritone) and the NBC Symphony Orchestra and Chorus conducted by Toscanini. HMV OALP1072/3.

One would almost be justified in agining that there is a conspiracy oot to rob Toscanini's recordings of eir rightful place in the library of corded music. With a monotonous nsistency, I find successive Tosmini recordings which give proise of something really fine being oiled by glaring recording faults. In this case it is mainly the use a studio sounding very like the famous "H" which has ruined any of his records in the past.

Not only is it painfully dead, but ere seems to be a ringing effect ther in the recording or somewhere ong the line which adds itself to e performance in the middle range here it sticks out like a sore finer.

Add to this a microphone placing hich insists on producing the same utput level for both singers and rchestra, so that they all seem parkd six inches from your ear, and you ave the general effect of this latest elease.

Traviata belongs to an operatic eriod which sounds very artificial modern ears. Each emotion and ramatic situation is the excuse for set aria, inevitably ending with a orid flourish which treats robust ealth and the last stages of conumption in exactly the same manner.

Its first performance was ruined rgely by the attempts of a weighty prano to overcome her natural disdvantages in the part.

OOR BLENDING

In this recording all these handiaps are highlighted unbearably. here is absolutely no blending of rchestra and singers at all, so instant have the engineers—or maybe oscanini—been to see that no note, owever slim, should be lost.

The result would be at times diculous if it were not so tragic.

It is possible that these records ould sound best on very ordinary quipment, where so many of these ings would be softened down. nder the microscope of wide-range ound they just can't be hidden.

There is some magnificent singg, particularly on the part of Alanese, who does much better than s Mimi.

But they are all wasted in the orst example of an ungenerous echanical mill. At least one side ounded as though there were some and in the works.

I can only register my sorrow, and ry to forget.

Capitol are doing well with their ptional centre, extended play 45's.

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The standard of pressing and recording is also first rate. The discs are used mainly for popular records, some of which will pass into the classic catalogue of this type.

Particularly good I found:—

CEP-015, Party Time from Julia Lee and her Boyfriends—King Size Papa, Snatch and Grab It, Ain't It A Crime and Don't Save It Too Long.

CEP-024, Cocktail Time with Ernie Felice Quartet—Dream A Little Dream Of Me, Street of Dreams, Solitude and Love Me Or Leave Me.

CEP-022, Dixieland Detour with Pee Wee Hunt and Orchestra—Panama, Between The Devil And The Deep Blue Sea, Stomp Off, Let's Go, and Livery Stable Blues.

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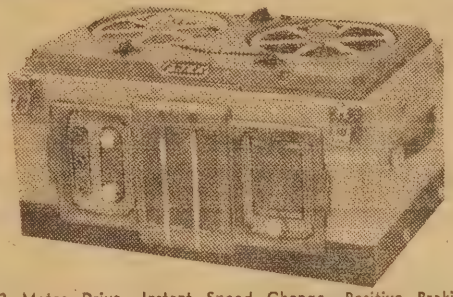

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SOME THOUGHTS ON DISTORTION

One of the fascinations about sound reproduction is that there is still so much to learn. Not only about the technical aspects of the matter but the fundamental problems of just what we are trying to do. The big danger is becoming too pre-occupied in single aspects.

By JOHN MOYLE

EVEN today, there are two fairly well defined approaches to sound reproduction.

One is the engineer's approach. He performs miracles of circuitry, measurement, design and what not, and expresses in figures most of the things he can hear and some that he cannot.

The other is the listener's approach—the man who starts on the assumption that the ear can not lie, and is the ultimate measuring stick of what is good and bad.

Today these two lines have come very close together. The engineer has cleared up many of the outstanding problems which obviously had to be solved. By means of amplifying and reproducing equipment he is now able to obtain sounds which the most critical are happy to pronounce as good. They are so good, in fact, that most people are quite happy with them.

NEVER SATISFIED

But the discriminating user of anything, be it motor cars or amplifiers, is never satisfied. His limits are far beyond those which will suit the average man. He will pay more, and wrestle endlessly with his subject in a tantalising search to reach the ultimate.

The engineer goes more and more deeply into frequency response and distortion. The listener will try this and that in an endeavor to get something better than he had before. Both tend to chase their own dogs up all kinds of alleys, and frequently lose sight of what they are really aiming at.

This isn't meant to condemn the efforts of either. We just can't get ahead without efforts of this kind. But it's a good thing every now and then to refer ourselves back to first principles, and ask whether we still know just where we are going.

The listener still maintains that his ear is the thing. But how many listeners still believe they are trying to reproduce an original? How many still come away from a concert hall with shaking heads, lamenting that their orchestral records don't sound like the concert they have listened to? How many build up more and more watts, and more and more speakers, until they virtually project themselves and everyone else backward through the front door in an effort to do the impossible?

ENGINEER'S PROBLEMS

The engineer, on the other hand, dives still more deeply into his response curves and distortion figures. He makes new and more cunning instruments to analyse this and to check up on that. He devises fresh terms to express what he is trying to discover, eliminate or use, only to find that when he has licked one problem, he has uncovered others.

Every now and then the two come together. In order to try and find a reason for listener reactions, special tests are held with all kinds of amplifiers, some with high and some with low power, with wide and limited response, with high and low distortion.

But when results are claimed for such tests, other well-informed people arise and throw the lot out of the window, on the grounds that they were wrongly founded, or the conclusions they led to were mistaken.

In all probability, neither w right. But somewhere in all su observations lies portion of the trut

Let me stick my neck out, ar comment on some of the things have just said.

One point I believe to be funda mental—that the ultimate impact sound is in the brain. It's not goi far enough to say that the ear the ultimate test. The ear is ju as much a link in the chain sound as any other part of ou gear.

The only real difference is tha we can't do much to change ou ears—we can only learn more abou them, and how they convey the intelligence to the brain.

But we can do a great deal abou our equipment, and we must lear to appraise it not as the net re sult of an isolated mathematical sum but by reference on the broades basis to what we are trying to d

An example of what I mean the changing yardsticks of amplifie performance.

Once upon a time frequency re sponse was the great thing. W "listened for the bass"—remembe the famous phrase?—and started t chase the highs, because at tha time lack of both was so drasti that most other things were mask ed by it.

DISTORTION

After a while we succeeded s well we became aware that the high particularly were pretty distressing We started to find out why, and cam across distortion. Distortion no became more important than mer response. Zero distortion was wha we wanted.

So we went to work on that.

Now we know quite a lot abou distortion. For some years it ha been a fetish to produce amplifier with fractions of 1 pc. Soon w found that frequency distortio wasn't the only thing—that musi sounded rotten if the single tone became mixed up with each othe when played together. We dis covered inter-modulation and bega to see that all these different kind of distortion were mostly variant of the same thing with the sam root causes.

But we found that some equip ments with distortion much greate than we thought allowable didn' sound bad, but others with smalle amounts of different kinds of dis tortion were intolerable. That mad us think. And today engineers ar beginning to think to such purpos that they suspect there are effect noticeable to the ear which so fa they have no method of measuring They are beginning to believe tha some types of distortion once though to be unbearable really don't matte at all.

They are realising that their onl line of attack in the future must b

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he broadest possible plane,' in-
ing psychology, biology, mech-
s, electronics and a still further
y of wave theory. I believe that
ly because of this widened and
htened approach, we may now
eed to really get somewhere.

was intrigued recently by the
of a textbook written by Pro-
or Olsen, one of the world's lead-
engineers on acoustics, elec-
ics, and sound. It was called
ical Engineering.

he enormous scope of this book,
rt from its significant title, is
vide as to amply illustrate the ap-
ach to which I am referring.

nce again, this matter of distor-
.. In a general way, all distor-
is thought to be bad, and to
ude anything which changes the
racter of the sound from the
ment it hits the microphone to
time we hear it.

ut in point of fact, there isn't any
l relationship between what the
heard at the performance and
at comes from the loudspeaker.
cannot transport ourselves by
y of reproduction into a hall. We
only take something which was
yed in a hall and given out from
loudspeaker a new type of sound
ich has much the same psycho-
ical effect on us as did the
ginal.

W MUSIC

We must realise that reproduced
nd isn't trying to give a faithful
itation of anything, but to give us
music in a new way which can
nd its ground in its own right.

From this view-point, everything
hear from the speaker is dis-
ted. It's very timbre differs from
e equipment to another. The
neral character of a voice or a
olin remains much the same, but
ere is a "coloration" if you like
nich is so different when heard on
o speakers, even of the highest
ality, as to be somewhat of a
ock if a quick change-over is
ade. And yet both speakers un-
ubtedly can give beautiful, clear
und for our delight.

**Does this mean, then, that distor-
on is only important when the re-
lts it produces are objectionable?**

At a recent meeting of the IRE in
dney, an excellent and well-in-
rmed lecture was delivered by two
gineers of first-class reputation
d ability. Their opinion was given
at the ear could detect micro-
opic percentages of distortion
early enough for its presence to
detected or otherwise.

NDS OF DISTORTION

And there isn't a shadow of doubt
at if we add very small amounts
distortion to pure sine waves
nder tests, the ear can tell the dif-
rence. And it's equally true that
ie addition of some harmonics, far
om being unpleasant, add interest
the tone, while others create
arshness and emotional tension
hich are difficult to bear for long.

But if we added tiny percentages
such distortion to the reproduc-
on of an oboe, for instance, whose
utput waveform is exceedingly
mplex, could we detect it then? I
m sure we could not.

I feel sure that a much greater
mount would be needed before we
ould even notice a change in the
mbre of the instrument. And even
we could hear the change—if the
eproduction became just a little
riller—isn't it conceivable that another oboe might have sounded that way in the first place?

There must be truth in this, for I am only one who has conducted listening tests by switching amplifiers of widely different characteristics from the same speaker and pickup before several practised hearers, who were unable to pick one from the other. And what is important, they all sounded equally good.

But a similar test with the same amplifier and pickup playing through a number of different loudspeakers showed up a shatteringly different result. In this case, there was no trouble in identifying the speakers almost without a mistake once the listeners had become used to them. Here our oboe was "distorted" by an infinitely larger amount, but the best of the speakers, although so different, still sounded equally good.

At the IRE meeting referred to, I asked a question, which was whether small amplifier distortions of one or even two pc were important when listening to music, remembering the large amounts of distortion which must take place in the chain of recording, cutting and processing the disc, playing it back with all the hazards of stylus fit and tracing distortion, running it through an amplifier and loudspeaker, and finally projecting the sound through the room?

(Continued on page 109)

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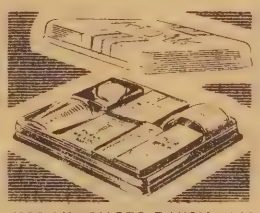

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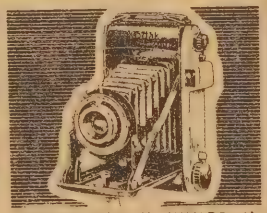

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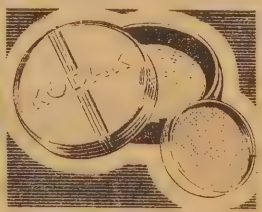

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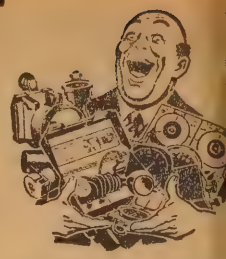

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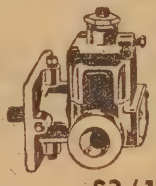

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RECORD NEWS FROM ABROAD

e interest in really high quality reproduction continues unabated. is month we hear of some really super discs and learn that wide- ige pre-recorded tapes are gaining ground. Neither has yet been seen out here.

By DISCOBOLUS

DIO enthusiasts have long been atered for in the matter of bet- ickups, amplifiers, and speakers those fitted to the ordinary stic radiogram; but the records have been using are the same. w an experiment is being tried the Westminster Company in rica, with the announcement ntly of a new limited series of ds made specifically for rior equipment. Westminster's ment goes on to say that "on e records there is no distortion, r harmonic or intermodulary, cho, reduction of high-frequency onse or stylus-bridging of inside ves."

ER RECORD

he edition is known as the West- ster Laboratory Series, and the release is a "superior" version Tchaikovsky's Capriccio Italien, Rimsky-Korsakov's Capriccio ngnol. Both items are by the don Symphony Orchestra and ducted by Hermann Scherchen. t this is intended to be a "super ice" is evidenced by the price, ch is seven and a half dollars for disc, as against just under six ars for the ordinary 12in LP's. ther companies will undoubtedly ow suit if Westminster meet with measure of success.

oing on to records which may y be called 'L'LP's, Vox have e up with five new discs, all of ch contain a large amount of gram material. The first of these ys for a few seconds under 63 utes and consists of the Romeo Juliet and 1812 Overtures, as l as the Marche Slav and Capric- Italien of Tchaikovsky. As all se works are scored for full or- stra, Vox are to be congratulated managing to fit them all on to disc.

FI RATING

f you hold the opinion that the ality would be open to question, would add that the Americans e classed the disc as in the Hi- field. The other four records are de up of four Beethoven Sonatas, otal of 55 minutes; three Mozart nphonies taking 59 minutes, three re Beethoven Sonatas running for minutes, and five works of Ravel ich take 59½ minutes.

At the other end of the scale, we ve a new English company, Con- t Artist Records, who have just oduced a 7in LP. It is LP to the ent that all 33 1-3 rpm discs seem be called LP's. Contents are about same as for EP45's, and the price also very similar.

I would expect the quality to be erior to that of the 45-rpm discs t they may offer some advantages those who possess only the two- eed motors, which must have been d in quite large numbers.

Decca 45's, which so far have been stricted to sale on the American arket, are expected to be an- unced shortly in England, and will probably be in the shops in time for Christmas.

Meanwhile, issues from all the English firms are continuing in great numbers. HMV have a new disc by Kirsten Flagstad of music by Wagner, played by the Vienna Philharmonic under Furtwangler, Suites by Bizet with Stokowski, Schubert's Symphony in C by the Halle Orchestra and Barbirolli, the complete Slavonic Dances of Dvorak with Nicholai Malko and the Philharmonia, and four Beethoven Sonatas, two each by Solomon and Myra Hess.

Columbia have issued the version of Cavalleria Rusticana by La Scala, in a recording said to be superior to Decca's, along with many other LP's, including four Mozart Concertos by Dennis Brain, and two more by Dennis Matthews. Gieseking has a new recording of the Schumann Concerto, and Johanna Martzy, a new violinist to me, plays the Brahms Violin Concerto.

PHILIPS ROYAL RECORD

Philips have a new release, about 20 LP's, from Pops to Classics, including among them a recording made in Adelaide last year during the Royal visit. It is called the South Australian Music Festival and was recorded from the ABC broadcast performance. Most of the discs in this release by Philips have already appeared in Australia.

NIXA have another big label at their disposal, with representation for American Cook records. These have long been famous for their unusual items and high technical quality, and many are in use as test pieces the world over. Cook were the first to sell publicly records with two separate tracks, giving true Binaural results if used on appropriate gear. So far, NIXA's list has confined itself to the ordinary Monaural recordings, presumably because the English manufacturers have not come up yet with a twin-arm pickup, which is needed to play them.

Incidentally, Cook records were the first I saw which arrived in the retail shop complete in a sealed polythene bag. Since then, record care has taken another step forward, with RCA's decision in future to press all LP's with raised centres *and* rims. Anything which serves to protect vinyl discs from scratches and the like will, I'm sure, be welcomed by all collectors.

AND MORE TAPE

Back to Tape for a moment—English Columbia are also on sale now, with half a dozen or so (Brahms 1st, Swan Lake, Sleeping Beauty, Rachmaninoff Concerto No. 2, Mendelssohn Italian Symphony with Beecham, Dvorak's New World by Galliera, plus Boutique Fantasque and music by Ray Martin). Most tape recorder manufacturers now have models designed for reproduction only, at reasonable prices.

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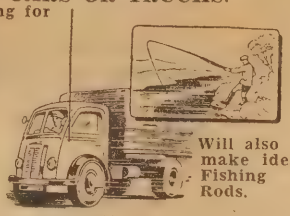

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Eng. 0-20 Milliamps, 2¾ dial, AC-DC 17/6
Eng. 20-0-20 Ampmeter, M/Coil . . 37/6
Eng. 0-30 Amps AC-DC 2¾in dial 42/-
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Stock and Die Sets, ½in, ¾in, and 1in water pipe, £4/19/6

IN FIRST CLASS ORDER DALTON COMPUTERS IDEAL FOR AERO CLUB 45/-

230 volt AC. NEON TESTERS, 4/6.

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6 volt . . . 70/-
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Complete with flex and switch.

At last! The spotlight you have been waiting for

Fitted with genuine American sealed beam globes. No motorist or boat owner should be without one.

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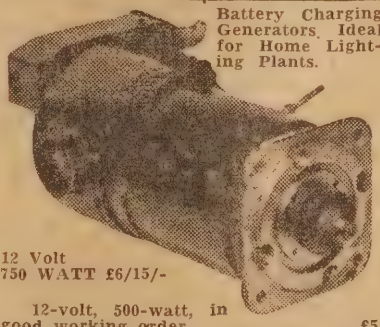

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12 Volt
750 WATT £6/15/-

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200 amp Generator. Ideal for welding. Made in America.
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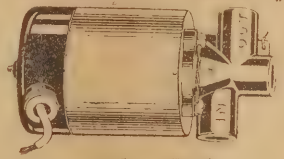
Will work off 12 or 24 Volt, ideal for Water or Alcohol Injectors.



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Useful on the rifle range, 3 draw 17in long, 6½in closed, 1in object lens, 18 magnification. Made in England **£7/19/6**

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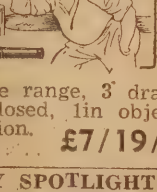
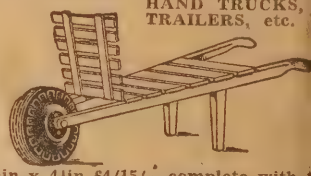
IDEAL FOR SHOOTING. FIT ONE TO YOUR CAR.



Fitted with Mirror Reflector. 6-volt 37/6. 12-volt 25/-

Brand new AEROPLANE WHE

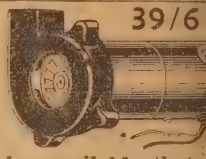
IDEAL FOR WHEELBARROWS HAND TRUCKS, TRAILERS, etc.



10½in x 4½in £4/15/-, complete with t

English Motor and Blower, 24 volts.

Will work off any Lighting Plant.



39/6

Large size also available that work off 12 or 24 volts £3/15/

Not Secondhand.

BRAND NEW ENGLISH G.E.C. RECTIFIERS

Make yourself a Battery Charger.

12v. 2 amp. 32/6
6v. 6 amp. 49/6
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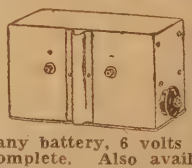
Transformers to suit above Recti 2 amp, 37/6; 6 volt, 5 amp, 45/-; 12 5 amp, 55/-.

COMPLETE BATTERY CHARG

Fitted with Brand New English Selenium Rectifier.



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Charges any battery, 6 volts at 4 a £6/15/- complete. Also available, 12 volt Chargers combined. Char amps, £7/15/-. Brand new 6 vo amp. Chargers, complete, £5/2/6.

ARMY FOCUSING TELESC

Easily converted for use on du levels. Can be used as a rifle si Excellent magnification . . £4/ Fitted with cross hai

ADJUSTABLE FOC

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8/ e

Ideal for mechanics, radio rep

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512 Elizabeth St., Melbourne, C.1.
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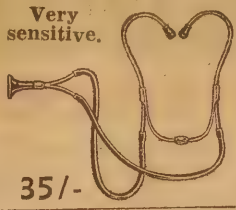
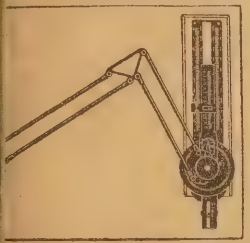
MECHANICS' STETHOSCOPES
Ideal for Testing Engines, etc.
Very sensitive.



35/-

R.A.F. PLOTTING BOARD WITH ARM



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70/-

IDEAL FOR ENGINEERS, STUDENTS, ETC.

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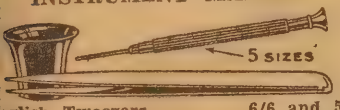

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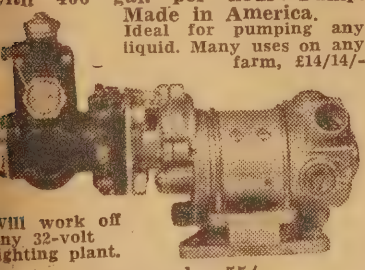
ctra strong Double Lens Eyeglasses 15/-
rewdrivers, set of five 13/9

eplace those broken side curtains ith cellulose acetate which takes e place of celluloid and lasts four mes longer. Will not discolor.

32/6 SHEET

on-inflammable acetate sheet is ecommended for all types of side urtains. Sheets are 20 thousandths f 1 inch thick. Size of sheet, 24in 52in. Can be sewn or cemented to frames.

ircraft 24 volt Motor complete ith 400 gal. per hour Pump. Made in America.
Ideal for pumping any liquid. Many uses on any farm, £14/14/-

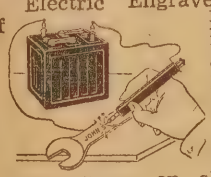


ill work off ny 32-volt ghting plant.

Pump only, 55/-.

ELECTRIC ENGRAVER

What everybody has been waiting for. An Electric Engraver that works off your car battery.



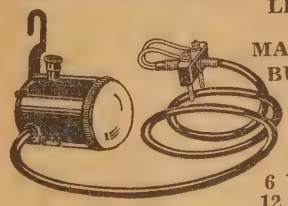
Ideal for name tags, dog collars, plant labels, etc.

Engraves anything in metal.

29/6

Engrave your name on all your tools. Marked tools are never stolen. No garage should be without one.

MOTORISTS' CLIP ON TROUBLE LIGHT



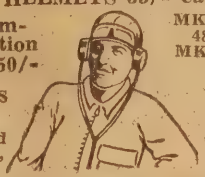
MAGNIFIED BULLSEYE LENS

6 Volt 7/6, 12 volt 6/6.
Complete with flex and plug.

R.A.F. LEATHER FLYING HELMETS 35/- each

Intercommunication Tubes 50/-

MK8 Goggles, 48/6 Pair. MK7 Goggles, 37/6.



PHONES 12/6

Polaroid Goggles, 48/6.

WOOL LINED FLYING BOOTS £5/15/- pr.

Genuine RAAF outer Waterproof Suits £7/15/-. All sizes.

45/- COMPLETE

Professional Magnifier with Stand and Extension Arm. Useful Doctors, Painters, Mechanics, Engineers, Photographers.

Brand new American Wobble Pump, semi-rotary

PHOSPHOR BRONZE VANES

Continuous flow, £3/19/6.

Ideal for caravans, emptying or filling petrol tanks, watertanks, etc.

24-VOLT MOTOR COMPLETE With Fuel Pump

Ideal for Caravans. Takes the place of Hand Pumps.

£5 each

Many uses on the Farm. Will Transfer Petrol or any Liquid from Drums, etc. Will work from 24 or 32 volts AC or DC.

SPRAY YOUR CAR, TOYS, HOBBIES, FURNITURE

52/6

Spray from your Spare Tyre.

An Ideal Tool for touching up damaged paintwork Will spray Lacquer, Paint, Enamel.

SPECIAL OFFERS

American Schrader tyre pumps, work from your spark plugs, **39/6.** Officers' solid leather shoes, black, **42/-.** Officers' boots, **45/-** pr. Canvas car tool rolls, **8/6.** American long blade jungle knives, complete with sheath, **15/-.** Large size white handkerchiefs, **1/6** each. 4½in saw blades, complete with arbor, ideal for making saw bench with electric drill, **25/-.** 6ft wide waterproof canvas, **17/6** yd. Bell-ringing generators, ideal for telephones, **25/-.** German Army marching compasses, work similar to prismatic, **29/6.** 110 volt 1000 watt prosector globes, **32/6.** 24 or 32 volt fractional HP electric motors, make ideal grinder mixers, etc., **50/-.** Small 12 or 24 volt hobby motors, **39/6.** ¼in Black and Decker 230 volt electric drills, **£11/15/3.** ½in **£24/8/3.** Fish pond aerators, work from 230 volts, **57/6.** All Steel Mechanics' Tool Boxes, Magnifying Glasses, 8 mags, **8/6.** 10 magnifications, **12/6.** Metal Drill sets, 1-16 to 3-16, 9 Drills for **3/6.** 24 volt motor and hydraulic pump, capacity 3½gals. per minute, **£3/15/-.** New headphones suitable for crystal sets, **17/6** pair. New Army Mosquito nets, ideal camping, **35/-.** Genuine RAAF Berets, **10/6.** Surveyors' Abney levels. New price **£18/18/-, £7/10/-.** Army paint, oil base, blue or grey, **25/-** gal. Brand new American Cutting and welding torches, **£4/4/-** complete. Army Slouch Hats in good order, **15/-.** Generator Test Meters, 35-0-35 amp meters, 4½in dial, **45/-.** 0-10 volt meters, 4½in dial, **45/-.** Loading Resistors can be supplied to make meter read 10.20 at **12/6.** Medical Scalpels, many uses, photographers, etc., **6/6.** Shaded Pole induction Motors made by Hoover of England, 230 volts, AC. Ideal for Projectors, Tape Recorders, Fans, etc., **£4/19/6.** SAE open end Spanners, 6 to set, **24/6.** Whitworth, 4 to set, **18/6.** 2½in Paint Brushes, set in rubber, special price, **10/6.** Brand new 7-8in Spark Plugs, suit most old type cars, **2/6 ea.** Tapped Transformers, 6, 12, 18 and 24 volts, 3 amps, **39/6.** 230 volts input Army Steel Tow Ropes with looped ends. **17/6.** SAE or Whitworth Spanner sets. Open one end, ring the other, 6 spanners to set, **23/6.**

SPECIAL! SPECIAL!
Just Arrived Sportmen's BINOCULARS
EXCELLENT QUALITY. Pair 39/6

BRAND NEW LEVER TYPE GREASE GUNS WORTH £4/19/6

59/6

Ideal for all types of Trucks, Tractors or Cars. 7500lb pressure.

ARMY FLUTES

39/6

Ideal for School Bands.
Never before at this amazing price.

SHORT-WAVE NOTES BY ART CUSHEN

TWENTY-TWO NEW ECUADORIANS

Ecuador rates second only to Brazil for the number of short wave stations since the introduction of a further 22 new stations over the past few months.

EXTENSIVE growth of low frequencies short-wave radio stations throughout Ecuador, are noted in a list of new stations issued by the World Radio Handbook. Brazil has some 75 short-wave stations and 2-million receivers, but Ecuador is only rated seventh in Latin-America with 45,000 receivers. Much of the interest in short-wave radio in Ecuador must be attributed to the extensive use of the radio as a means of education and missionary work in that country.

The 60-metre band is the most popular for the new Ecuadorians, and in this band, ideal for tropical broadcasting, and free from the jamming which must reduce the primary coverage of the short-wave stations using higher frequencies, some 13 stations are located.

Italian Schedules

THE schedules of Radio Italiana in Rome are requested by Mr. R. Ricciaroli, Amomoor, Q, who has been unable to hear the broadcasts from Rome. During the coming summer months, listeners in Australasia will be able to hear Rome at its best in the Pacific transmissions which they broadcast for this area 7.0-7.35 pm daily.

The English section of this transmission is 7.25-7.35 pm. Program in Italian for the Australian listener is broadcast from Rome at 4.50-5.45 pm. These two transmissions are broadcast on 15120, 17800 and 21560Kc.

The Home programs of RAI are released on 6260Kc during the evenings, and though this broadcast is not directed outside Europe, signals are often good, and the station can be heard from opening at 5.30 pm on Sundays, 6 pm weekdays over the 5000W transmitter at Palermo, using 6260Kc, are relaying the Italian second network.

DZH7 NOW 10KW

The Far East Broadcasting Co., Manila, which operates seven short-wave frequencies, has increased the power on 9745Kc to 10KW. Tests on DZH7 on this frequency have been heard by several readers, Peter Barclay, Balwyn, Vic, reports hearing the announcement that the transmitter being tested was using a new north-south directional antenna.

Later a east-west directional aerial was tested, and reports requested from listeners hearing these test broadcasts. At 6 pm the 15300 and 17805Kc transmitters are well received, and at 8 pm low frequency outlet DZB2 on 3340Kc provides good listening when a session of news is broadcast.

DZH7 and the other outlets relay the broadcast band station DZAS in Manila, and are operated by the Far East Broadcasting Co., PO Box 2041, Manila.

FEN IS 10KW

The Far East Network transmitter which is being well received on 11750 and 6160Kc is a new 10-kilowatt Gates transmitter which was put into service on July 7.

This information is contained in a verification letter from Mr. R. H. Phillips, chief engineer of the Far East Network, Tokio. The station at present is operating on 1175Kc 9.15-8.15 am, and on 6160Kc 7.0-9.0 am, 8.30 pm-1.0 am. The antenna is a V-beam.

These notes are compiled by Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Eastern Australian Standard Time.

NEW TRANSMITTERS

Further new transmitters have been placed into service by VOA, including Okinawa-3, which is operating on 9630Kc 8.30 pm-7 am. Relays on BBC transmitters include the use of two new frequencies, 7235Kc 2.15-2.45 am, 9725Kc 4.45-5.30 am. BBC transmitters GRX (9690) and GWO (9625) have been heard to 6.15 am, while BBC transmitter MCT (11960) opens at 6.15 am with a VOA relay. Philippines-3 the latest short-wave transmitter at the new Luzon location, operates on 17780Kc from opening at 8.30 pm.

The new stations:

Kcs.	Power (Watts)	Call	Location	Slogan
4470	250	HC2MX	Guayaquil	Radio Guayaquil
4750	250	HC5HN	Cuenca	Radio Hermig
4755	300	HC6LJ	Guaranda	Radio La Voz de Bolivar
4780	200	HC1LC	Quito	Radio Atahualpa
4810	250	HC3RS	Loja	Radio Coro Santa Cecilia
4830	200	HC6GB	Latacunga	Radio Nacional Espejo
4870	250	HC4DR	Bahia	Radio Mirimar
4920	200	HC2MD	La Libertad	La Voz de la Peninsula
4945	250	HC1RQ	Quito	Radio Quito
5020	250	HC6EM	Ambato	Radio Cosmopolita
5025	200	HC5AL	Cuenca	Radio Astral
5195	300	HC6GT	Ambato	Radio Continental
5965	250	HC5GE	Riobamba	Radio Mundial
5970	200	HC1JT	Tulcan	Radio Jota
6000	200	HC6VM	Latacunga	Radio 11 de Noviembre
6020	300	HC4DY	Esmeraldes	Radio Iris
6070	200	HC2AQ	Guayaquil	Nueva Radio Ortiz
6100	250	HC5JA	Cuenca	Radio Atenas
6140	200	HC5FD	Riobamba	Radio Federacion Depertiva
6170	200	HC2PJ	Babahoyo	Radio Fulminense
9570	200	HC3JZ	Zaruma	Radio Fenix
11765	200	HC2AU	Guayaquil	Radio Ortiz

FLASHES FROM EVERYWHERE

NAIROBI'S new 3315Kc transmit which was logged last month by Len C lett, Oamaru, NZ, to 6 am, is a 250 station, reports the World Radio Ha book. This transmitter operates 4.30 am in addition to the 4885Kc transmit of 6000W which broadcasts in English 9.0 pm, 1.0-6.0 am (Sunday, 5.0-9.0 and 1.0-5.0 am Monday). Hindust broadcasts are carried on 3315Kc 1.45- am, and on 6060Kc 8.0-9.0 pm. The Afri vernacular programs are broadcast the African information services on 6060 7.0-8.0 pm, 10.30 pm-1.30 am, and 7240Kc 1.30-3.0 am.

BERNE'S November schedule inclu the new program, "A Penny-A Son which replaces the popular request p gram, "Mail Order Melodies", heard the Australasian transmission on Mond at 6 pm. The idea for the new progr has come about as a means of helping International Red Cross. Listeners sho make a donation to the local branch of Red Cross and then send the receipt, gether with the name of the number th wish played, to the Swiss Broadcast Corporation in Berne. The transmissi from Switzerland from November 1 w be broadcast over HER5 (11865), HE (15305), and HEI5 (11715), from 5.15 7.45 pm, the latter portion of the tra mission being for reception in West Australia and the Far East.

A new service for listeners on the w coast of USA is now operating from 2. 3.0 pm, using HER3 (6165), HER2 (605 HER4 (9535). Switzerland's home serv in German and French is relayed on sho wave from 3.15-4.40 pm on HEI5 (117 (from 3.55 pm on Sundays), 8.0 pm-10 pm. HER7 (17784), 12.45-8.30 am, H (11715).

JAPAN'S rebroadcasting stations for local NHK network programs have be noted on two new frequencies, JKC using 6005Kc having been heard at f strength at 8 pm, with light side int ference from Manila on 6000Kc. Anoth outlet, 3370Kc, heard at the same ho is using a frequency which is now signed to the Nippon Hoso Kyokai, Tok

Signals are weaker on this frequen and not as good as the Noumea (3350) DZB2 Manila (3340) signals. Another n station on this band is on 3390Kc, he with news in Dutch at 8 pm, and we p sume this is the Hollandia, Dutch N Guinea, station, which has moved h from 5045Kc. Tokio's 4910 JKI transmit has a new service of news in Engl which is broadcast 7.55-8 pm daily.

THE VOICE OF VIETNAM operating 11904 and 15018Kc, has been heard throu out Australasia, and in North Ameri with a transmission in French 8.0-9.0 p The broadcasts include a news session French, which is sometimes presented 8.30 pm. The location of the station is known; it does not appear to be "Voice of Vietnam", which is operated the Vietnam Government on 9620Kc.

From the type of program it would pear to be a communist-controlled stati with the location possibly in the n Vietminh section of the country. station has also been reported from No America as using 11930Kc, but reception that hour is not possible, due to the BB GVX using the frequency.

HAITI'S two transmitters are being ported by Rex Gillett in Adelaide as be received at good strength in the eve ings. The missionary broadcaster 4V using 9559Kc opens at 9 pm with nouncements in French, English Spanish. The station announces pow at 3000W and the location is Cap Haiti

A program of organ music follows opening announcement. Haiti's capi Port-au-Prince, is the home of Ra Commerce, 4VC, operating on 9485Kc w 7500W. Signals are good when the s tion opens at 9.30 pm but Morse int ference is often severe. 4VRW Ra Haiti, also in Port-au-Prince, operates 10075Kc, and has been heard at 10 pm a again in the early mornings

THE HAM BANDS WITH BILL MOORE.

The linking of capital cities on the 144 MC band by a group of relay stations is a new venture on these frequencies. It shows the enthusiasm of the VHF radio amateur and improvement in techniques and equipment in recent years.

URING the first weekend in October the initial Eastern Australian 144 Mc d day was conducted to link together tions in that part of the continent. t was arranged by the VHF section of NSW division of the WIA assisted VHF groups and amateurs in Vic- ia, Queensland, South Australia and smania.

The spring field day was aptly termed peration Centipede".

The main object was to provide the ilities for relaying messages between k stations on the 144 Mc band from ate capital to State capital. Three nets re arranged incorporating portable d home stations. They did not follow e shortest route but were varied to ow all stations in the selected general rection to participate.

The first net was to the north via link tions to Inverell and then over the rder into Queensland.

The second was to the west over the ue Mountains and into Victoria and en South Australia. The third net arted from Sydney, moved south to umut into Victoria and then it was pped into Tasmania.

NTERSTATE LINKS

Links to two States were provided uring the day both via the western et, the first message passing to Victoria nd the second later in the day to South ustralia. The messages were originated y NSW State president of the WIA nd were addressed to divisional presidnts.

The day officially opened at 1030 hours nd the messages were transmitted by K2WI. Activity was so extensive that was difficult to follow closely the rogress of the messages along the varius nets. The full story will not unfold ntil a complete summary is prepared y the NSW VHF section which is desirus of obtaining reports on the day's vents.

It appeared early on the Sunday that ropagation conditions would assist the peration.

As the day progressed it was shown hat extended ground wave working was ossible only in certain areas.

Some 40 stations participated from field nd home locations. Operating in the ield in NSW were the following stations nanned in some cases with up to four perators: VK2ANF/P Bell, Blue Mountains, VK2AOA/P near Canberra, VK2ATO/P Barrington Tops, VK2HE/P Mt. Ebor, VK2HL/P north of Goulburn, VK2HO/P Mt. Gibraltar, VK2LG/P Mt. Tomah, Blue Mountains, VK2BQ Adelong, VK2ZAA near Batlow. VK2BW/P Mt. Maxwell near Wagga, VK2OA/P near Goulburn, VK2YR/P Mt. Canoblas, Orange, VK2WJ/P Bundanoon, VK2ABO/P Yetholme, VK2AZO/P Mangrove Mountain.

HOME STATIONS

Stations active from their home QTH's in the city and country included VK2APP, VK2AJO, VK2VU, VK2ANU, VK2JX, VK2XX, VK2ALJ, VK2WH, VK2RU, VK2PM, VK2KS, VK2PN, VK2AQI, VK2AJO, VK2EI, VK2AQE, VK2RS, VK2AGY, VK2ATS, VK2EW.

Messages for the three nets were originated in Sydney at 1030 hours. The message for the southern route was handled by link stations until received by VK2AOA/P near Canberra who could hear VK3UI but was unable to establish contact.

The western net was successful in relaying its message through to Melbourne and during the evening into Adelaide. The link across the border being provided by VK2ZAA, Batlow, and VK3UI, Mt. Stanley.

The interstate link for the Adelaide message was provided by VK2AJO Coolamon and VK3ATN Birchup. The Sydney-Melbourne relay was completed on the 144 Mc band in 55 minutes—under two hours for the outward and return handling, the following stations participating: VK2WI, VK2KS, VK2JX, VK2ANF/P, VK2ABO/P, VK2YR/P, VK2EI, VK2WH, VK2ZAA/P, VK3UI/P, VK3BQ and VK3WI. The reply was relayed along the same route.

The net made amateur radio history, the first 144 Mc VHF link between capital cities. An interesting thought for the organisers of Civil Defence communication systems.

The participants were rather disappointed that the VK3ATN-VK2AJO Birchup-Coolamon link was not open during the day.

Propagation conditions were apparently unsuitable—they are so bad in fact that Ray, VK3ACN, heard only one station during the day.

LATE CONDITIONS

He even entered the telephony section of the VK/ZL DX contest during the afternoon to fill in time. Late in the evening after a resume of events on the 80 metre band it was decided to try again to relay the message to Adelaide. VK2AJO passed the message to VK3ATN immediately on opening up on 144 Mc who in turn passed it to VK5BC in Renmark who made the final link to his brother VK5HD in Adelaide.

The reply was returned via the same stations and then to VK2WH Forbes, VK2YR/P Mt. Canoblas, and VK2ANF Sydney, to be finally received at 2355 hours.

The northern route to Queensland was covered to Barrington Tops north of Newcastle where VK2ATO after a long climb with walkie-talkie equipment made some excellent contacts with only two-tenths of a watt input.

He contacted VK2JX and VK2LZ Wentworth Falls, 140 miles, and VK2HO/P near Mittagong, 180 miles. The link was also complete from VK2AQI Armidale, through VK2ATS Inverell, to VK4TY. VK2HE/P who operated from Mt. Ebor, between Barrington Tops and Armidale, was unable to contact stations at either location.

An extremely interesting point was clearly shown by the test that a complete 144 Mc home station link is available from Sydney to Adelaide.

The route would commence from VK2ANF Sydney, over a 170-mile path VK2WH Forbes, then 100 miles to VK2AJO Coolamon, 260 miles to VK3ATN Birchup, 170 miles to VK5BC Renmark, and 130 miles to VK5HD in Adelaide.

The outstanding signal from Victoria was from VK3UI/P at Mt. Stanley near Beechworth. The operation was the combined effort of VK3UI, VK3CI and VK3JK. They were heard by VK2ANF in the Blue Mountains at a distance of 270 miles.

It was pleasing to see one of the LAOCP gang VK2ZAA making excellent contacts from his portable location.

A number of parties carried HF equipment besides their VHF gear to assist in lining distance contacts and proved valuable at times.

The whole operation was only possible due to the extensive checking and organisation that preceded the field day. For weeks previously stations had been active lining up equipment and relay routes.

CHECK ON 80

The 80 metre band was used extensively to arrange and check test transmissions on 144 Mcs. The enthusiasm of the country amateur made possible the effective linking of stations and more field days will undoubtedly be arranged to hold their interest. The venture was ambitious but the results obtained were extremely gratifying to the organiser.

It is certain that the next field day run upon similar lines will be well supported. There is already discussion on the problems of originating a message in Brisbane and relaying to Adelaide.

The essential points of the net operation were arranged by the committee of the NSW VHF section comprising

ANNUAL FIELD DAY AT WOY WOY

An extensive program has been arranged for the NSW division's annual Woy Woy Field Day and those attending are assured of an interesting day. Amateurs and their families from the area Newcastle to Sydney will gather and meet amateurs from other districts.

Attendances during the last five years have always exceeded the 200 mark, and this year's event should be well supported.

Assembly will be between 10.30 and 11.00 am, the venue the Masonic Hall, Woy Woy, the date November 21. No prior booking is required—just arrive with your family and friends.

Make Woy Woy the location for your Sunday outing, the ladies and kiddies will be entertained by special events.

The morning session will commence at 11 am with competitions. An all band scramble will be held from 11.45 to 12.30 and lunch break will be from 1 to 2 pm.

At 2 pm searchers will leave to locate the hidden transmitter on 144 Mcs, transmissions from which will cease at 3.15 pm. During the afternoon special competitions will be conducted for the ladies and races for the juniors.

A general reunion and prize presentation will be held from 4 to 5 pm.

Woy Woy field days are the best demonstration you can give your wife of amateur radio—bring her along—it is good propaganda.

SWISS UHF CONTEST

The Swiss National Society, the USKA conducted the 1954 All European UHF Contest. The event, run exclusively on the 144-146 Mc band, the 50 Mc band not being available in most European countries, was well supported. Full use of these frequencies is dependent largely on contests which create great interest and ensure increased population of the bands.

Portable operation was encouraged during the contest period of 24 hours.

The scoring was arranged on a distance basis with no points scored for contacts under six miles, 22 points for contacts between 350 and 500 miles and 50 points for all contacts over 700 miles. First QSO's with each new country or district gained participants twice the listed point score.

Last year's contest opened up a number of new paths and improved the countries' total of a number of stations.

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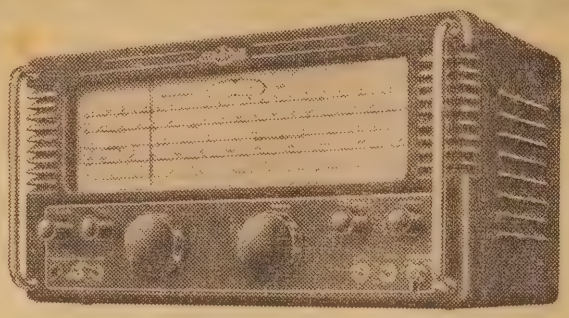

EDDYSTONE "750" RECEIVER

FREQUENCY RANGE: Band 1—32 to 12 Mc.; Band 2—12 to 4.5 Mc.; Band 3—4.5 to 1.7 Mc.; Band 4—1465 to 480 Kc.

VALVE LINE-UP: Eleven valves perform the following functions:—

R.F. Amplifier 6BA6	Det., A.G.C. and A.F. DH77
Mixer (S.F. to 1620 Kc.)	N.L., S Meter Diodes
ECH42	6AL5/D77
Oscillator 6AM6/Z77	Output N78
Fre. changer (to 85 Kc.)	Beat Freq. Oscillator 6BA6
ECH42	Rectifier 5Z4G
I.F. Amplifier 6BA6	Stabiliser VR150/30

ELECTRICAL PERFORMANCE: Double Conversion Superheterodyne. Sensitivity is better than 5 microvolts for a 15 db signal/noise ratio at all frequencies.

SELECTIVITY is variable over the range 30 db to 60 db down 5 Kc. off resonance. Image ratio is better than 40 db at 30 Mc. and greater at lower frequencies.

AUTOMATIC GAIN CONTROL: Output level is maintained within 15 db for a 90 db change of input, above 3 microvolts at 6 Mc.

AUDIO OUTPUT: Maximum output is 3.5 watts. Pick-up terminals are fitted and audio stages give linear amplification over a wide frequency range.

S METER: A socket at the rear accepts the Cat. No. 669 Signal Strength Meter.

FINISH: Fine black ripple.

Weight 40 lbs., width 16¾in, depth 10in, height 8¾in.

Price **£128/7/7** (inc. Sales Tax, Speaker extra)

EDDYSTONE "840" RECEIVER

FREQUENCY RANGE: Band 1—30.6 to 10.5 Mc.; Band 2—10.5 to 3.7 Mc.; Band 3—3.8 to 1.4 Mc.; Band 4—205 to 620 Metres.

VALVE LINE-UP:

R.F. Amplifier UAF42	Output UL41
Frequency Changer . UCH42	Beat Freq. Oscillator UAF42
I.F. Amp. and A.G.C. UAF42	Rectifier UY41
A.F. Amp. and Det. UAF42	

ELECTRICAL PERFORMANCE: Sensitivity is better than 10 microvolts for a 15 db signal/noise ratio.

SELECTIVITY: 30 db down 10 Kc. off resonance. Image ratio better than 15 db at 30 Mc. and correspondingly higher at lower frequencies.

AUTOMATIC GAIN CONTROL: The delayed A.G.C. system maintains the output within 25 db for a change in input of 80 db above 3 microvolts. A.G.C. is switched off when the B.F.O. is turned on.

POWER INPUT: Inputs of 100/115 volts and 220/250 volts are catered for, and current consumption is approximately 0.275 amp. The receiver operates equally well from D.C. or A.C (25/60 cycles) mains.

FINISH: Fine black ripple.

Price **£103/6/2** (inc. Sales Tax, Speaker extra)

EDDYSTONE "680X" RECEIVER

FREQUENCY RANGES: Band 1—30 to 12.3 Mc.; Band 2—12.5 to 5.3 Mc.; Band 3—5.7 to 2.5 Mc.; Band 4—2.5 to 1.11 Mc.; Band 5—1120 to 480 Kc.

CIRCUIT: Fifteen valves perform the following functions—

Two R.F. Amplifiers .. 6BA6	Two Audio Amplifiers 6BR7
Frequency Changer .. 6BE6	Push-Pull Output 6AM5/EL91
Separate Oscillator	Beat Freq. Oscillator 6BA6
6AM6/Z77	Noise Lim., S Meter
Two I.F. Amplifiers .. 6BA6	6AL5/D77
Detector and A.G.C.	Rectifier 5Z4G
6AL5/D77	Voltage Stabiliser VR150/30

ELECTRICAL PERFORMANCE: Sensitivity for 50 milliwatts, 15 db signal/noise, ratio, 4 microvolts or better on all ranges.

SELECTIVITY: Bandwidths at 6 db down—Minimum 14 Kc., first intermediate 7.5 Kc., second intermediate 4 Kc., maximum 2.5 Kc., and greater with crystal switched in and phased.

AUTOMATIC GAIN CONTROL: 9 db change of output for 100 db change of input, above 1 microvolt at 9 Mc.

FINISH: Polychromatic Grey.

Weight 47 lbs., width 16¾in, depth 13¾in, height 8¾in.

Price **£206/18/4** (inc. Sales Tax, Speaker extra)

EDDYSTONE "740" RECEIVER

FREQUENCY RANGE: Band 1—30.6 to 10.5 Mc.; Band 2—10.6 to 3.7 Mc.; Band 3—3.8 to 1.4 Mc.; Band 4—205 to 620 metres.

VALVE LINE-UP:

R.F. Amplifier EAF42	Beat Freq Oscillator EAF42
Frequency Changer . ECH42	Output EL42
I. F. Amp. and A.G.C. EAF42	Noise Lim. and S Meter EB41
A.F. Amp. and Det .. EAF42	Full Wave Rectifier .. EZ40

ELECTRICAL PERFORMANCE: Sensitivity is better than 10 microvolts throughout for a 15 db signal/noise ratio and 50 milliwatts.

SELECTIVITY: 30 db down 10 Kc. off resonance. Image ratio better than 15 db at 30 Mc. and greater at lower frequencies.

AUTOMATIC GAIN CONTROL: A change of input of 80 db affects the output by less than 25 db.

S METER: A socket at the rear accepts the Cat. No. 669 S Meter.

FINISH: Fine black ripple.

Weight 30 lbs., width 16¾in, depth 10in, height 8¾in.

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nt Perc Healy, VK2APQ, secretary Miller, VK2ANF, and members Finch, VK2OA, Roy Hart, VK2HO, Lapthorne, VK2HL, and Harry ons VK2AJZ and with the assist- of country VHF enthusiasts they d that another page was written ateur radio in Australia.

publicity was given to the field ver the national news on the fol- Tuesday.

AMATEUR WEEK

latest source of publicity for ur radio in the US is the proclama- of State governors declaring the ation of amateur radio weeks in arious States.

the announcements reference is to civil defence and distress gency communication working of hobby, and to the contribution in past to national defence.

governors urge all citizens to exert influence and good will toward the vation of the occasion.

resolution is at present pending in Judiciary Committee in the United s Senate.

calls on the President of the United s to declare each year the third in June as Amateur Radio Week.

il defence organisation is, according ress reports, at last reaching a stage some definite proposals will be coming. It is hoped that at some d the communication aspect of the will be discussed and amateu. operators may receive an opportun- o co-operate.

bile operation on the HF bands is on the increase and becoming in- singly popular. Under good conditions mber of VK's are contacting ZL's both 7 and 3.5 Mc using a few watts elephony.

DDEN TRANSMITTERS

r the initiated, 144 Mc hidden trans- er searches as held on field days e become relatively simple, and with experience gained transmitters are g located in a few minutes.

o increase the difficulties in these nts the Hunter Branch introduced ng its spring field day held in ber at Blackall's Bay, a blindfold Mc search, competitors setting out foot.

cleared area of a few acres is re- red, the searchers were supplied with guide to ensure they did not injure mselves or their equipment by con- ing trees or buildings, but otherwise e unaided in the search.

our sets of receiving equipment were use and heats were run to locate transmitter some 200 yards away. e event not only provided greater blems and more interest but consider- e entertainment for all present.

K/ZL CONTEST

his year's VK/ZL DX contest received y fair support from Australian ateurs. Propagation conditions could classed as good by current standards. Activity among foreign stations, especi- y in Europe and Asia, was an improve- ent over last year. A number of K's tallied over the 100 contact mark thin reasonable operating time.

It appears under the present conditions é contest, as with other DX events, s lost much attraction and it is per- ps too much to expect that amateurs ho experienced the DX of six or so ars ago to operate for any long period. revival may be experienced with the lvent of more sunspots.

OSTA RICA AWARD

A new certificate is awarded by the adio Club of Costa Rica to amateurs ho can fulfil the following requirements The certificate will be granted to any ation proving he has contacted seven rt of the eight zones of Costa Rica Any authorised amateur band and phone r CW may be used.

QSO's must be dated after November). 1945, the date when amateur com- unications were re-established in Costa ica.

Confirmations must be sent to the adio Club of Costa Rica, PO Box 535. an Jose, Costa Rica.

The zones of Costa Rica are as follows:

T12—San Jose, T13—Cartago, T14—Heredia, T15—Alajulla, T16—Limon, T17—Guanacaste, T18—Puntarenas, T19—Cocos Island.

Lower power transmitting enthusiasts have a new outlet for their ideas with the introduction of transistors. The QRP society in Great Britain recently arranged special transistor transmitting tests. Held on three consecutive evenings for a period of 15 minutes participants called QRP Test TTX. Using Morse code at a speed of 10 WPM the tests were conducted on the 160 metre band.

Claude Zlici is at the moment the leading exponent of the 3.5 Mc DX around these parts. He is of necessity very active and always contacting the odd new country on this band. He is rather impressed with the recent FCC decision to allow extended 3.5 Mc operation in the US Pacific Islands and the possibility of a number of new countries.

Previously most of these territories were not areas in which amateurs could operate on this band.

Baker, Canton, Enderbury, Guam, Howland, Jarvis, Palmyra, American Samoa and Wake Islands are assigned the band 3500 to 3900 Kc/s. Most of these areas are readily contracted on the band and a new telephony station will add quite an amount of DX interest here in Australia

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A LIGHT-WEIGHT PORTABLE SET

(Continued from Page 67)

set out of the cabinet, being very careful not to disturb the gang setting. Now adjust the padder until the chosen station is received at maximum strength. Assuming that the gang has not been moved, the padder should now be correctly set and will need no further adjustment. However, it would be wise to slip the set back in the cabinet and check the calibration.

Now, with the set out of the cabinet, the slug in the RF coil should be adjusted, using 2FC or a similar frequency signal, and this should be followed by a rough adjustment of the rod aerial. This is done by simply sliding the coil along the rod until the strongest signals are received. The position is quite sharp and will increase the signal strength considerably.

HIGH FREQUENCY END

Now move to the high frequency end of the band and set the pointer on an appropriate station, say 2SM in NSW. Adjust the oscillator trimmer until the signal is brought in at this position and follow this with adjustment of the RF and aerial trimmers. It is a good idea to check the low frequency end again, followed by a further high frequency check.

Finally, the set should be fitted in the cabinet and the aerial rod adjusted at the low frequency end of the band and the aerial trimmer at the high frequency end.

Complete ready-made cabinets should be available from your dealer, but you can save quite a worthwhile amount by making your own. Details are given in a drawing elsewhere in the article, and anyone handy with tools should have no difficulty in working from it.

The sides and bottom are made from 3-8in ply, and the remaining portions from 3-16th ply. The bottom is fitted inside the two side portions to give maximum strength, and the whole job is assembled with panel pins and glue.

HINGED BACK

The back is hinged to the bottom and held closed by means of a double ball catch at the top. Both the back and front have slots to allow exit of the sound and quite an appreciable amount of sound is available from the back of the cabinet. This is quite a worthwhile feature.

Three blocks of 3-8in ply are fitted to support the chassis, one in the corner near the RF valve, one near the IF transformer, and one near the volume control. This latter should not be hard against the top of the case, to allow space for the shielded leads under the chassis. The height of these blocks will be approximately 1in, but the exact size should be adjusted to allow the speaker to rest firmly against the baffle.

The baffle is made from 3-16in ply and the dimensions are given in the drawing. Note the elongated holes, which facilitate the fitting and withdrawal of the chassis.

To allow enough room for the double ball catch the aerial rod must be mounted about ½in from the top of the case. The rod we used was supplied with two small spring catches to hold it, and these were mounted on two 3-8in blocks to provide the necessary clearance. Ot types of rod use aluminium brack and these may be long enough, even too long. In the latter ev they may be modified without much trouble.

Whatever form of bracket is us it must not constitute a shorted t around the rod, otherwise the eff ency will be seriously reduced.

Fitting the set into the cabinet not difficult, it being slipped in at angle with the two control sha through the cabinet holes and the r lowered in last. The chassis is a fr tion smaller than the cabinet in t direction to make such a manoeu possible.

The final finish of the cabinet pends on your own personal ta It may be painted with one of glossy enamels which are read available, or it may be covered w leatherette. Either arrangement quite satisfactory, and you may plea yourself which you choose.

Bias in Magnetic Recording

(Continued from page 73)

corded frequency of 400 cycles p second) as a function of the outp level and is indicated for several bi currents. These four curves are di tributed around the optimum val of bias current.

TYPICAL CURVES

The curves (Fig. 6 and 7) show t relationship of the reproduced sign to the amount of supersonic bi current used in recording, for vario types of tape. The audio current the recording head is held consta at a level about 20 db below that r quired to give a 1 pc distorted sign

The optimum recording bias is a proximately that giving the peak ou put, but in many cases, a somewh greater bias will give a steadi signal. However, there may be son differences due to different reco heads, levels of recording or equa isation.

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ME THOUGHTS ABOUT DISTORTION

(Continued from Page 99)

hat question evoked much in-sting and well-informed discus-—but no answer. There can-be an answer. The question asked to highlight this very nt, that we can't evaluate on ening quality by talking about k percentages of distortion. Because if those tiny percentages ervable as changes in the sound a pure wave were important, n the final result from a modern crogroove, containing as it does, ny, many times more distortion, uld have been intolerable. But, as we know very well, good ords today don't sound intoler-e—they sound jolly fine.

The truth is that only certain nds of distortion are objectionable, d it is those we must regard as r prime enemy. Until we get ay from the habit of bulking all istortion" under one heading, we en't at the starting post to sort t what our problem really is.

And, in estimating how much dis-tion we can tolerate we must re-e our ideas not to a simple sine ave, but to the extremely com-ex waveforms produced by the in-ruments we are reproducing.

We must realise that the lack of mething required of a first rate system may make it sound less interesting or convincing than another, but it may not necessarily make it sound bad.

We must accept the fact that a loudspeaker which may measure 10 pc distortion, may sound very good, because not all that distortion registers unfavorably.

We come to the inevitable conclusion that the emotional impact of the sound we hear is perhaps the key to the whole matter of distortion and that the composer who balances sweet sounds against harsh sounds is merely varying the harmonic distortion of his music to that end.

I'll leave it there at the end of a somewhat rambling attempt to widen the ambit of the reproductive eye. And after a sentence like that it's time I did!

Let's Buy an Argument

(Continued from Page 79)

ould change from minus 6 to plus

Can you imagine what would hap-en to the plate current (and the alve), remembering that V4 would ormally be the output valve?

The last question we have room or actually concerns series net-vorks. In essence, applied to figure , it would run this way:

The series filament connection as hown provides only 4.5 volts of bias or V4, which is insufficient for a S4. Would it not be possible sim-ly to reverse the connections to he filament of this valve to put its egative filament pin 7.5 volts above earth?

To be sure, there would be the equisite potential between the two conventional reference points — grid and filament minus. However, the other side of the filament would not truly be "filament plus", because it would now be negative with respect to "F—".

The mean or average bias, referred to the centre of the filament, would still be minus 6, as before.

One could, in fact, go on and talk at length about all the ramifications of series filament circuits. Perhaps we should leave that one for another day.

Your Amateur Licence

(Continued from Page 87)

If the pentode required 10,000 ohms, the artio would be 1-1.

In our circuit we have left out the voltage amplifiers needed to lift the microphone level sufficiently to drive the modulator. Their output reaches the modulator grid via C3. The modulator is biased by its cathode resistor R3 bypassed for audio by C6, the grid being returned to ground through the resistor R2. RFC is a radio frequency choke often used to prevent any RF currents from reaching the modulator.

We have shown two sources of high tension, but if the power supply is big enough, it could supply both valves.

When modulating a pentode valve, we must modulate both plate and screen in order to achieve 100 pc modulation. This is generally done by connecting the screen through a suitable dropping resistor to the active end of the modulation transformer secondary. The screen is bypassed to ground for RF, but the capacitor should not be large enough to bypass the audio impressed on it.

Control Unit No. Six

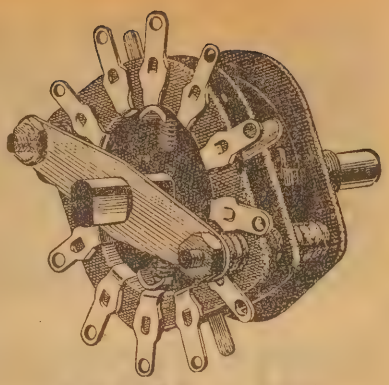
(Continued from Page 55)

ciable voltage across them, and their ratings may be low.

To obtain exact conformation with response curves, it is a good thing to bridge all values before wiring them in, but variations of say 5 pc should not be serious.

The same chassis, panel, and escutcheon are used as for the control unit four, and we are supplying drawings for the brackets to the chassis makers. You can easily knock them up for yourself from aluminium scraps. They are mounted symmetrically four inches apart, and easily clear the switches and volume control.

We are very happy with this unit. It costs a little more to make than its predecessors, but it is so foolproof, flexible, and its performance is so good that we think it well worth the trouble. It can be used with any of the Playmaster amplifiers, and incorporates the best features of them all plus some of its own.



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CONTACTS—
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Resistance—800 Micro-Ohms.

TEMP. RISE ON CONTACTS—
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at 10 Amperes 10° C. rise
at 20 " 30° C. rise
at 30 " 50° C. rise

DECKS—1 to 8 max.

POLES PER DECK—
1 Pole—max. 12 contacts
2 Pole—max. 6 "
3 Pole—max. 4 "
4 Pole—max. 3 "

OVERALL DIAM., 2-1/16 in.

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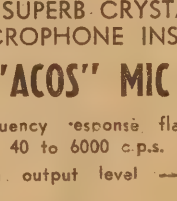

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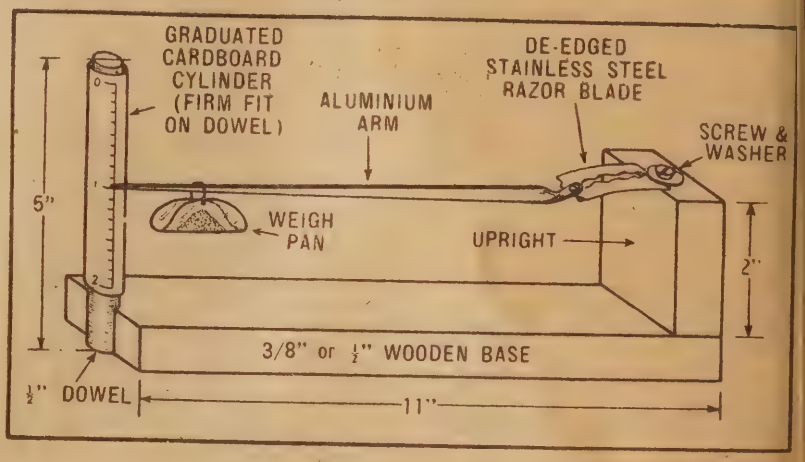
SIMPLE PHOTOGRAPHIC BALANCE MADE FROM SCRAPS

Our major item this month gets completely away from electrical gadgets, being a very simply constructed chemical balance which is submitted by Mr. B. M. Byrne, of 91 Main Avenue, Rainworth, Queensland. Naturally this will appeal mainly to photographic hobbyists.



ALTHOUGH the idea appealed to us for its utter simplicity as much as anything, Mr. Byrne assures us that it is capable of a high degree of accuracy. In support of this he points out that it was mainly intended to permit making up small quantities of color developers; a rather exacting task in which, apparently, it has been completely successful.

The base is made from a piece of timber 11in long and about 2in wide. 3-8in or ½in timber would be suitable, either solid or ply. The upright portion is about 2in high, measuring from the top of the base.

The heart of the device is the spring which consists of a stainless steel razor blade, de-edged to prevent accidents. The brand of that used in the original was a "Swing", but if this is not readily available it would seem that almost any similar type could be used. The stainless characteristic would appear to be desirable, but not absolutely essential.

One end of the razor blade is anchored to the wooden upright, using a wood screw and washer, and to the other end is fastened the cantilever arm and pointer. The pointer is made from 18-gauge aluminium and is tapered slightly from the blade to the pointer end. It is also twisted through 90 degrees at the blade end to match the horizontal mounting of the blade.

At the other end of the block is mounted a length of wooden dowel ½in in diameter and about 5in long. Over this is fitted a length of cardboard tubing, and on which is marked the scale graduations. The tube should be a firm, sliding fit on the dowel, thus providing a means of zero adjustment by sliding the tube up and down the dowel.

The weigh pan is made from a scrap of cut film from which the emulsion has been stripped and is attached to the lever arm by means of a brass wire hook. Although Mr. Byrne does not suggest it, it would appear quite feasible to attach another weigh pan to the arm, much closer to the razor blade, and which would provide a multiple, say 10 times, of the main scale.

For the original model the sensitivity is given as approximately 2in/gram, and is substantially linear. This sensitivity may vary somewhat with different types of razor blade, but should be of the same general order.

Calibration is best achieved using standard gram and grain weights. These may be bought from most potographic stores for a moderate price, or may be borrowed for purposes of calibration. It is quite likely that many readers who already possess a balance of some kind, may wish to make this for use with very small quantities. In this case weights will be readily available.

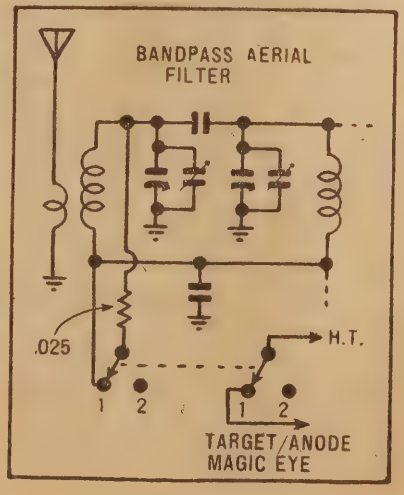
ADDITION TO WIDE-BAND TUNER

FROM another reader comes a suggested minor modification to one of the Playmaster Wide Band Tuners. To the non-technical members of the household these tuners are sometimes a little difficult to tune accurately, particularly at the low frequency end where their broad characteristics are most pronounced.

Even a magic eye is inclined to be confusing, since a properly adjusted circuit will produce an almost flat response or even a double hump effect with a slight trough in between. Tuning should be in the middle of the trough, but this is difficult to reconcile with the requirement at the high frequency end where a definite peak is evident.

This is overcome by fitting an extra control on the front of the chassis which serves to temporarily spoil the band-pass characteristics while the set is tuned. It is a two pole, two position switch, one section of which is used to connect a .025 meg. resistor across the aerial coil. Under these conditions the response will show a rounded but definite peak which will operate the eye in the usual way.

The second section of the switch controls the HT supply of the eye, applying HT only when the band-pass characteristic is eliminated. Thus the procedure becomes one of switching on the eye (and wrecking the band-pass) when a station is to be tuned in, and switching it off again (and restoring the band-pass) after it is correctly tuned.



FROM THE SERVICEMAN WHO TELLS

(Continued from Page 43)

visualise the outer coil slipped or down the former until it is ve or below the inner one. Then same rule applies.

he reverse is true in the case converter where plate and grid the active electrodes. Here the ve elements go to opposite ends he coils.

n this case it needed only a few nents to confirm that the cathode ding did not follow this rule , since I have never known it to , I felt pretty certain this was trouble. Sure enough, reversing connections set the valve oscil- ng merrily and the set came to .

ORE TROUBLE

But our troubles were not yet er. Although working, the set was initely unstable, a fault which it my roving eye over the HT line search of the paper by-pass which ould always be fitted in addition the last filter condenser. When I uld not find one I picked up a mfd which happened to be lying the bench and bridged it from to chassis. The instability van- ed and the set performed really ell, considering its age.

Having fitted a permanent HT by- ss I rounded the job off with align- ent of the trimmers and padder, hich made just enough improve- ent to give it an impressive per- rmance. Naturally the owner was ore than pleased.

The absence of a paper by-pass is very frequent source of trouble sets of this vintage and it can use a lot of trouble. In fact it is ne of the most frequent causes of scillator failure and I must confess at I had temporarily overlooked on this occasion until it presented self as a cause of instability.

Apparently set designers of the good old days" were prone to omit is condenser, either through norance or in an attempt to econo- ise. Unfortunately one could do his and get away with it, because a ew electrolytic is usually good nough at RF to keep everything unning nicely, at least for a while.

DRY ELECTROLYTIC

But sooner or later the last elec- rolytic would dry out sufficiently o present a high impedance at RF, even though it continued to function well enough as a filter. The first effect would be instability due to he high impedance in the common RF and IF return path, followed by oscillator failure as the impedance became higher still.

As for the "175" stamped on the aerial coil can, and which had so misled the owner, well I can only write that off as another unsolved mystery. Perhaps it was simply a manufacturer's type number which happened to be the magic number, or maybe the aerial coil had originally belonged to a set which did operate on 175 Kc. Even so, I can't see the reason for marking the aerial coil with this figure, since the chosen IF would make no difference to aerial coil design.

And speaking of unsolved mysteries, I want to refer to a case which I described recently (June, 1954) in which a set suffered a severe loss of gain due to the volume control being very much below its marked value. Actually it was marked .5 meg. and read 20,000 ohms and, try as I might, I could find no explanation as to how it came to be that value.

The evidence was against it always having been low, yet the owner claimed, and it appeared from the soldered connections, that it had never been replaced. In the circumstances I could only replace it with one of correct value and pass the story on to my readers as the mystery of the month. Now the Technical Editor has just handed me a letter which might well contain the solution to the mystery.

LOW CONTROL VALUE

It is from Mr. R.C.M., of Christchurch, NZ, and details a similar case which he recently experienced It appears that he had barely finished reading the June article when he encountered a job with similar symptoms. After having checked virtually everything else, with no result, he suddenly remembered the article and checked the volume control.

Sure enough it was low, reading only 10,000 ohms instead of the marked .5 meg. Naturally a new control of the correct value restored the performance of the set, which was then returned to the owner.

Puzzled, as I was, as to how this change could occur Mr. R.C.M. also quizzed the owner, but with rather more success than I had. It seemed that the control had previously become rather noisy and someone had advised the owner that a temporary repair could be effected by rubbing the element with a piece of soft pencil lead.

This he had done, and it had cured the noise. Unfortunately it had also added a layer of graphite of much lower resistance than the original element, with the result that the resistance was reduced to one-fiftieth of its original value.

Thinking back on my own case I am more than half convinced that the same thing could have happened.

When I first made mention in these colums, some years ago now, of a character who "lubricated" his speaker with liquid glue I apparently started a craze for collecting unusual methods of butchering speakers. Many of these have been my own experiences, others have come from readers, and they all add up to a collection of some of the most ingenious schemes one could imagine. In fact, I thought I had heard everything, but this latest one will take a lot of beating.

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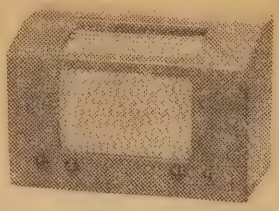

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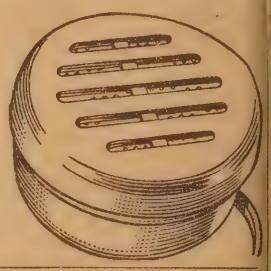

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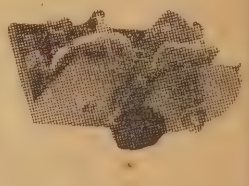

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Valves used 2.354, 1.1T4, 1.1S5, 1.1R5 **£7/10/-**

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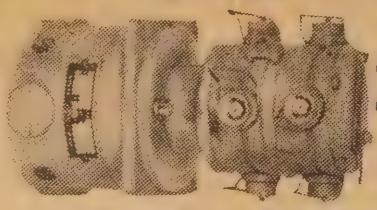

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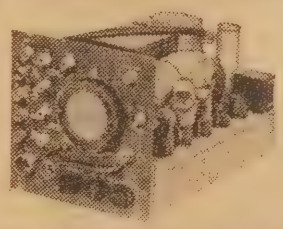

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SPECIAL PRICE FOR QUANTITY
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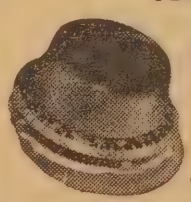

American velvet vernier dial 100 to 1 calibration. Supplied with ceramic coupling **20/-**

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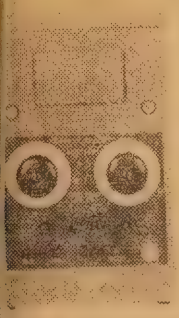
Converted for 240v. AC operation



Including power-supply, 9" x 7" ovaltone speaker

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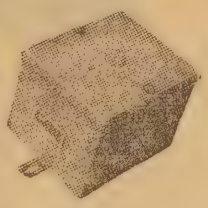

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Circuit supplied free with all A.R.8 receivers

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T.5 Transmitters supplied complete with valves (3-807 and 6V6), plug and circuit
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250 ohm, 25 watt.
50 ohm, 2½ amp; 25 ohm, 1 amp
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Freq. range 90 to 130 m/cs contains 17 6.3 volt valves.

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Complete with corrector **17/6**

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23 pin plug for MN26 compass 37/6.
18 pin plug for MN26 control box, 25/-.
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0-.5 amp. RF thermocouple	9/6
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(All above are 2in flush mount.)	
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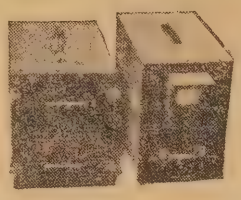

Cathode Ray Oscilloscopes. Complete with power supply to operate off 320 volts A.C. are in working condition. C.R.O. 3" Tube Type 3 A.P.I.

Tube line up 2-6V6G, 2-6A. C7/1852, 1-6H6, 1-6J.7G, 1884-IV.R.92 (VHF Diode) X & Y Amplifier with internal continuous time base 125 to 50,000 C/S and external triggering time bases.

This unit can also be used for aligning television receivers with the use of the external time base. Worth £75, our price only £27/10/- with power supply. **£17/10/- less power supply.**

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A robust unit with input adjustable by switches for 220-240/260 volts A.C. 50 c/s.
It employs a 5.V.4.G. L.V. Rectifier and an 879 H.V. Rectifier H.V. output can be varied by a switch on the front control panel to any of the voltages. 750/1300/1900.
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Brand new B.C. 733D Aircraft Radio Receiver. An U.H.F. receiver complete with Genemotor to operate from 24/28 volts D.C. It employs a crystal controlled oscillator and operates on any of six frequencies from 90 to 120 megacycles.

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Price with Genemotor £12/10/- less Genemotor £10.

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All brand new and in good condition

1 Watt Resistors listed in ohms — 250, 300, 350, 400, 450, 500, 600, 650, 800, 850, 1000, 1500, 2000, 3000, 4000, 4700, 5000, 6000, 10,000, 12,000, 15,000, 25,000 30,000, 40,000, 60,000, 70,000, 75,000. .1 meg, .15 meg, .2 meg, .25 meg, .3 meg, .35 meg, .5 meg, .75 meg, 1.5 meg, 1.75 meg, 2.3 meg, 3 meg, 5 meg.
Price only 4d. ea. 3/- doz, £1 per 100.

½ Watt Resistors listed in ohms.
50, 300, 500, 000, 2000, 2200, 5000, 10,000, 20,000, 25,000, 30,000, 40,000 50,000 60,000, .1 meg, .25 meg, .3 meg, .5 meg, .3 meg.
Price only 3d. ea. 2/6 doz, 16/8 per 100.

¼ Watt Resistors listed in ohms.
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Price 3d. ea., 2/3 doz., 15/- per 10
Wire Wound Resistors. Bargains in Wir Wound Resistors are available as fo lows: —
3 Watt 7, 12, 21 ohms .. .. 8d. e
5 Watt 200, 350, 450, 550, 600, 650, 70 800, 1000, 1200, 1250, 1500, 2000, 300 3500, 4000, 4500, 5000, 6000, 7000, 900 10,000 ohms. Price 9d. each.
10 Watt 100, 125, 750, 5000 ohms. Pric 1/- each.
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Type R89. A.R.N.5 Radio Receivers

(Type R.89 A.R.N5) Radio Receivers
Operates on either 332.6, 333.8 or 335 megacycles. The operating frequency is changed by changing the crystals. Complete with 3 crystals 6597.9, 6522.92 and 6547.92 K/cycles. It is designed to operate from short straight dipole antenna and balanced transmission line. Tubes used. 2-12SN7 7-6AJ5 1-12.S.R.7. 1-28D7.

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ANSWERS TO CORRESPONDENTS

R. (Macksville, NSW) writes to ex- s his approval of the suggestion that publish some data on gas analysers similar equipment.

: Many thanks for your comments R. and we will add these to the list avor of such an article. At the moment cannot be sure whether such equip- t would be suitable for home con- ction, but we are investigating the ibilities.

. G. E. (West Preston, Vic.) favorably iments on the Serviceman Who Tells the Let's Buy An Argument series also submits two question for the ver Tom Page.

.: Many thanks for your letter, K.G.E. trust that the magazine will con- ue to hold your interest in the future. ir queries for Answer Tom may prove eresting to our readers and we are ing them aside with a possible view inclusion in a future issue. In reference the copy of R & H which you had not eived at the time of writing your er we have passed on this information the appropriate department.

. R. T. (Wembley, WA) writes to con- atulate us on the commencement of series of articles on "Getting Your nateur Licence" and feels confident at he will be, at the end of the series, the position to pass the PMG examina- ons.

A.: Many thanks for your compli- entary letter, A.R.T. Since the begin- ng of the series we have had a number such letters and are pleased to hear the assistance these articles are im- rting to prospective amateur operators ch as yourself. We trust that the llowing articles will enable many more obtain the ability and confidence and in the "ranks of Radio Amateurs of ustralia".

E. V. (Birrong, NSW) is puzzled why amplifier using two new valves isn't pparently as good as a much older one.

A.: We won't attempt to answer your uery in these columns but have put it side for discussion in the "Answer om" pages, as you have suggested.

D. H. (Ormond, Vic.) sends in a year's ubscription and would like some infor- ation on the "Jewel Auto Pack" for ars, as advertised in the May, 1954 issue f R & H.

A.: Thank you for your subscription, D.H. which has been passed on to the appropriate department. In reference to the "Jewel Auto Pack", we are unable to offer any information on this unit, but suggest that you write direct to the advertisers at Reid's Radio Service, 412 Bridge Rd., Richmond, Victoria for full details.

W. P. (Mossman, Q) sends a subscription for 12 months Radio and Hobbies and comments on the Senior Signal Tracer. He also mentions an idea that he has been using for some time, namely a plough disc as a speaker baffle.

A.: Many thanks for your subscription W.P. and we have forwarded it to the appropriate department. We are glad to hear that you found the Signal Tracer article so valuable and that the magazine in general continues to interest you. Your story of the baffle is very interesting but we think you would find that exactly the same results would be obtained from a flat wooden baffle of similar dimensions. The Argument article in the September issue covered this in detail and you can no doubt appreciate the main purpose of the baffle better after reading it.

A. K. G. (Dee Why, NSW) sends an interesting story concerning electric shocks obtained from a faulty electrical system and inquiries as to how this could come about, as it apparently contradicts the usually accepted ideas.

A.: Many thanks for your letter A.K.G. and the interesting story it contains. It is rather difficult to fully explain the "live" tank, since it would probably need a thorough investigation of the set-up. However, the shock which you received from the earth wire is rather more easily explained and is all summed up in the fact that it is wrong to assume that any earth connection is automatically of a very low ohmic value. In fact it can be very high and earth is naturally a very poor conductor. The reason that it is claimed that the resistance between any two points on the surface of the earth is only a few ohms is because the cross sectional area of the earth (the conductor) is so large. However, making a low resistance connection to the earth is quite another matter and is sometimes very difficult. Some supply authorities specify certain tests to ensure that the earthing is effective, but these requirements vary from one supply authority to another. We have passed your letter on to the serviceman for his possible comment.

W. A. B. (Toowoomba, Q) asks us a number of questions regarding various components

A.: The sealing compound to which you refer is probably a varnish rather than a wax and is rather difficult to remove with most of the common solvents. We can only suggest the use of physical force to break these seals. The 6M5 valve is very similar in characteristics to the EL3 in its various forms. Miniature ceramic sockets have appeared on the market from time to time, though they are mostly imported and not in very good supply. The mica filled plastic type are nearly as good and readily available. Suitable size holes for the Octal, miniature seven, and miniature nine pin sockets are 1 1/8in, 5/8in, and ¾in respectively. A dummy aerial is a useful addition to a signal generator if precise sensitivity measurements are to be made, but is not essential for normal service work. We have not seen the unit to which you refer and so cannot comment.

R. P. (Inverell, NSW) is interested in amateur radio communication and wants some details of the type of equipment which would operate from a six or 12 volt accumulator and also details of the licence requirements.

A.: By this time you have probably seen the first few instalments of the series we are running for readers like yourself and designed to cover the examination requirements. For equipment we refer you to the June, July, and September, 1953, issues of Radio and Hobbies which described transmitter, receiver and vibrator power supply for amateur use. The equipment was also designed for AC operation. Some army disposals equipment can be modified for use on the amateur bands but it requires a considerable knowledge of what is required before this can be tackled.

R. G. (Double Bay, NSW) submits a couple of questions for the "Answer Tom" page.

A.: Many thanks for your letter R.G. Your questions have been filed for future reference

J. E. W. (Dubbo, NSW) sends us a subscription for 12 months for Radio and Hobbies and comments on the quality of the magazine over the past 12 months. He also comments on the reaction of different listeners to the quality of recorded sound and quotes some problems of his own gear.

A.: Many thanks for the subscription J.E.W. and this has been forwarded to the appropriate department. We are also glad to hear that you have found the magazine so interesting and we will do our best to keep it that way.

Your postal query will have been handled by the time you read this but we suspect from the brief mention of your trouble that it would be due to a pronounced peak in the pickup. The article on baffles will also have appeared and we trust it will answer many of your questions. An infinite baffle is simply one which the path length between front and rear waves is so long that it ceases to effect the radiation for all practical purposes. The chimney idea is not a new one, but it would not form an infinite baffle. The complication is that a chimney represents a resonant air column which may lead to exaggerated output in the extreme brass register. It's a matter of try it and see.

T. I. M. (Bellevue Hill, NSW) submits a circuit of a simple two-way telephone system.

A.: Many thanks for your interesting letter, T.I.M. We are filing your diagram with a possible view to including it in the "Reader Built It" section of the magazine in a future issue.

THE "RADIO & HOBBIES" QUERY SERVICE

ALL queries concerning "R & H," designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to others readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three "R & H" constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis will now be 4/6. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, "RADIO and HOBBIES," Box 2728C, GPO, Sydney.

Note that "RADIO & HOBBIES" does not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

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Operates from any 6 or 12 volt car battery. Low battery consumption. Engraves on all metals. Engrave your name on your own tools for your protection against theft. Also engrave name or fancy designs on cigarette cases silverware, brooches, metal tags, etc. No skill required to operate. Price, **50/-**, post free. Money back guarantee.

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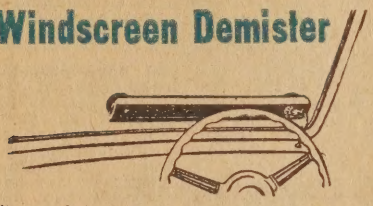

Fit a windscreen demister and enoy safer driving. Prevents windscreen fogging. Keeps vision perfectly clear so that you can relax and drive in comfort. Operates from car battery. Low battery consumption. **Draws only 2 amps.** Easily fitted. No holes to drill. Suction cups hold it firmly against windscreen. These demisters are strongly made, have an attractive appearance and they are guaranteed for two years. Supplied complete with switch and flex. Only **50/-**, post free. Please state if 6 or 12 volt model is required. Money back guarantee.

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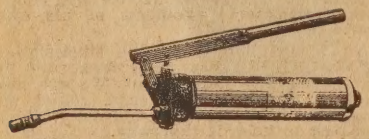

An extremely powerful lever type grease gun for cars, trucks, tractors and machinery. The gun exerts a pressure of **7500lb.** Yes, it forces grease into the nipples at a pressure of over **3 tons** per square inch. This means that the grease is definitely forced into every part of a bearing.

It is far more **powerful** than the ordinary type of car grease gun. Soft, medium, and heavy greases and oils can be used. This rugged **heavy duty** grease gun is 18 inches in length, and it's guaranteed for two years. Price **£4/10/-**, post free. Money back guarantee.

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No brushing
No spraying
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Dries one hour
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or lapmarks
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Get beautiful high gloss mirror finish that looks like a spray job

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Sapphire Enamel is the result of a new formula perfected after years of research. It flows on so smoohtly without leaving a single blemish. No previous experience is required, because it's so easy to use. No need to remove the old enamel or lacquer. Simply clean the car and then wipe on Sapphire Enamel. The special applicator wipes the enamel on so mirror smooth, so easy that you'll be delighted with the brilliant new look of your car. One quart is sufficient for painting a car and one coat covers any other enamel or lacquer.

16 smart, popular colours for you to choose from. Whether your car is an old or late model, Sapphire will give it that high gloss like new appearance . . . and not a single brushmark marring its surface.

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White	Dove grey
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Cream	Cherry red
Light cream	Russet red
Rich cream	Maroon
Light stone	Dark maroon
Mid stone	Chocolate
Fawn	Sky blue
Pastel green	Light blue
Light green	Royal blue
Lawn green	Navy blue
Dark green	Yellow
Grey green	Black

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Enclosed is .....
Please send immediate delivery the following items:—

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R.H.11

Please write in BLOCK CAPITALS

Name .....

Address .....

NEW FOUR-BAND RECEIVER

(Continued from Page 39)

ency end of the band and adhe slug in the broadcast oscilcoil until the station is tuned correct spot on the dial. Adjust ug in the broadcast aerial coil the station is received at best gth.

w tune in a station toward the frequency end of the dial, say and adjust the oscillator trimcapacitor until it is tuned at its ct spot on the dial. Adjust the l trimmer capacitor for maxistrength.

the interests of accurate adnent, it is advisable to deliberselect weak stations appearing nd the dial positions mentioned lightly couple the aerial to the y disconnecting it from the terl and wrapping the insulated of the lead around the aerial inal.

this stage, the IF transformer s can be adjusted. Select any c stations and adjust the slugs r greatest strength from the on. Go over the adjustments e.

or those readers who will have rvice oscillator to aid them, the nment of the short-wave coils is y straightforward. If the service llator uses a "dummy aerial" re- e it and clip the oscillator output s to the aerial and earth terals of the set, across which a 400 n carbon resistor has been placed. et the service oscillator to the uency for each of the bandspread tions as mentioned in the pamet accompanying the coil unit adjust the slug in the oscillator for that band until the signal uned at the correct spot. Adjust slug in the aerial coil for that d for maximum signal from the vice oscillator. Repeat for the er short-wave bands.

For these coil slugs, it is best to ke up an insulated "screwdriver" shaping the end of a small sliver wood. The use of a metallic screwver may make adjustments a little fficult if you are not experienced short-wave circuit alignment.

f you have trouble indentifying short-wave coils for each band d no information is given in the accompanying pamphlet, here is their arrangement in the unit which we used.

The associated aerial and oscillator coils are on the same color former with a different color for each band. The aerial coils are mounted between the first and second wafer of the wave-change switch, counting from the front, with the oscillator coils between the second and third wafers.

Working away from the 6AN7 socket, the coil pairs are for the 31, 19 and 25 metre bands in that order.

If you are without the aid of a service oscillator, the procedure is not so clean-cut. The first step is to adjust the slug in the aerial coil for each band until the noise level "peaks" at a maximum. Do this with the dial pointer at about the centre for the 31 and 25 metre bands and toward the end for the 19 metre band.

The adjustment of the oscillator coil slug to bring stations to their correct position on the dial will have to be done after listening tests have established the amount of discrepancy between the announced frequency of operation of a station and its observed position on the dial.

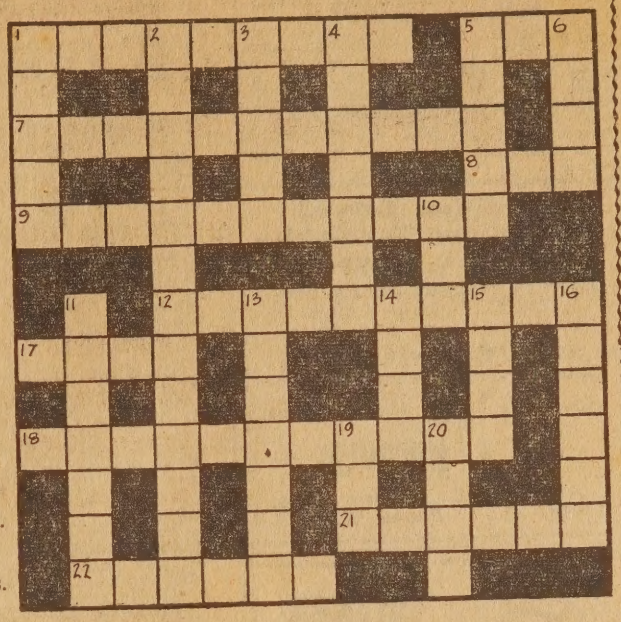
If possible, make these checks around the dial positions mentioned above. Once you have firmly established that a station is operating on such-and-such a frequency, you can adjust the oscillator coil slug to bring it in at about its correct dial position. Do this for each short-wave band.

Any adjustment to an oscillator coil slug should be followed by "peaking" the slug in the associated aerial coil.

Even if you have used an oscillator to set the bands, some touching up may be necessary after specific stations have been identified. The reason is simply that few service oscillators are completely accurate in their dial markings.

One final point — the design of a bandspread unit may well affect its alignment procedure and notwithstanding the foregoing discussion, it is best to follow the manufacturer's instructions if the unit differs from the type which we used.

THE R. & H. CROSSWORD No. 8



ACROSS

1. Converse of wavelength.
5. Postmaster-General (abbrev.)
7. Type of aerial system.
8. Finale.
9. Type of motor.
12. Between valves.
17. Unit of loudness.
18. General term for electron movement.
21. A type of grid.
22. Summoned.

DOWN

1. Diminishes.
2. Used in superregen. receivers.
3. To go in.
4. Popular singer.
5. Magnetic focal points.
6. Controls electron flow.
10. Home of color TV.
11. Basis of French polish.
13. Four-element valve.
14. Reception confirmed (abbrev.)
15. "- - - - H" aerial.
16. Phonograph pioneer.
19. Cathode-ray screen (abbrev.)
20. One loop of wire.

Solution and further crossword next month

Solution to puzzle September issue

C	H	A	S	S	I	S			R		T			
A		C		E			C	O	H	E	R	E	R	
L		C		S		R			C		N			
L	O	U	D	S	P	E	A	K	E	R	S			
S		M		I		E			P		I			
I		U		O		N	E	U	T	R	O	N		
G	A	L	E	N	A		M		I		N			
N		A			D		P		O			M		
S	A	T	U	R	A	T	I	O	N			E		
		O			P		R			W		T		
F	O	R	E	S	T		E	U	R	O	P	E		
O			M		O			S		W		R		
G			F	A	R	A	D	A	Y			S		

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R D S

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Cost of Classified advertisements in this section is 2/- per line, approximately five words to a line. Closing date for December issue of Radio and Hobbies is Wednesday, November 10.

SALE: Pair English E.M.G. hand-made miniature high-fidelity moving coil pickups for L.P. & 78. Both have diamond styll and are complete with mu-metal transformer and common screw-in base. Superb instruments, cost over £40. Perfect condition, little use. Sell £25 the lot or near offer. **Blain c/o A.B.C., Hobart.**

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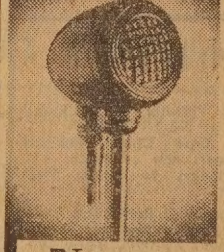

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